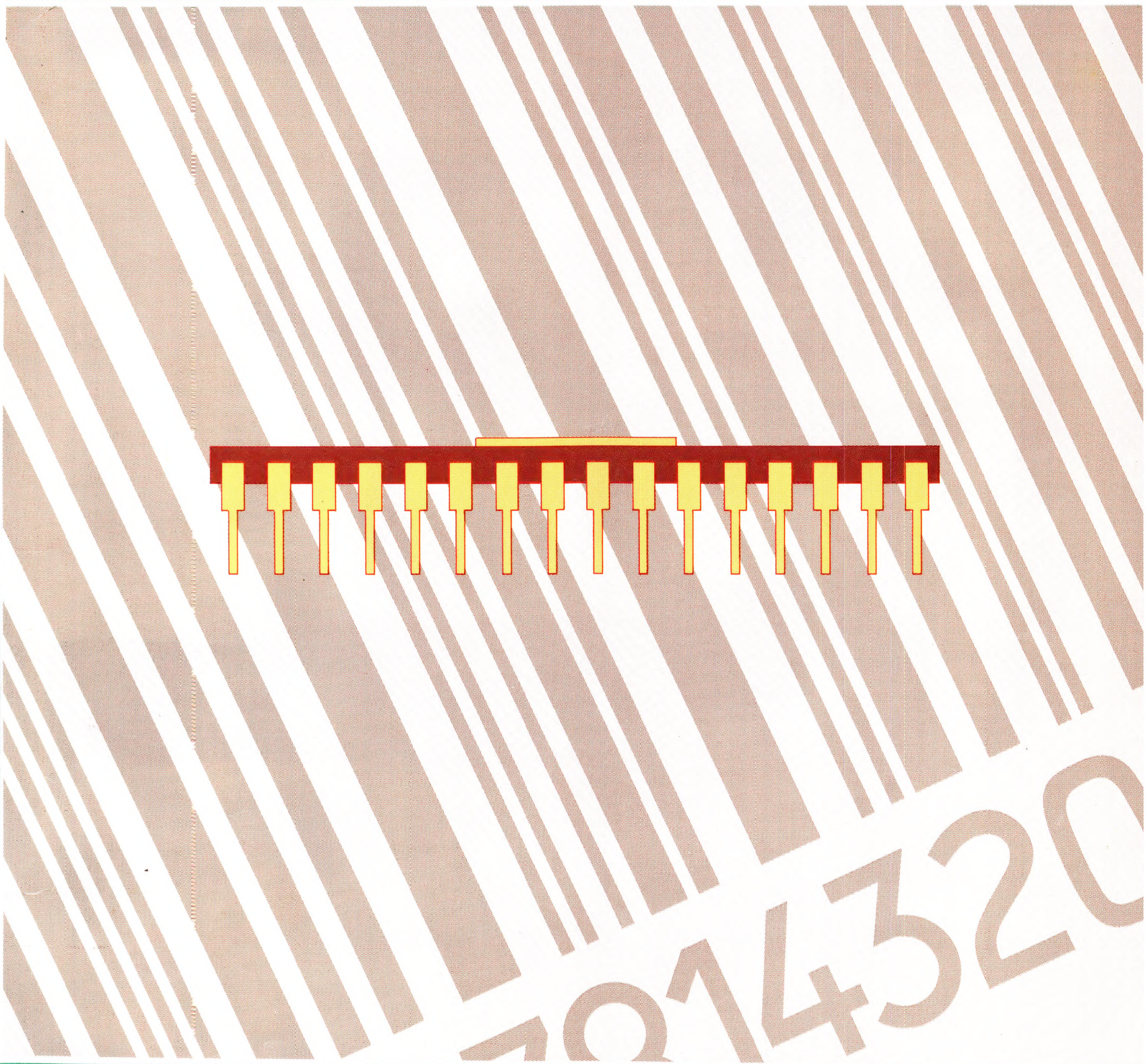
A McGRAW-HILL ELECTRONICS PUBLICATION
OCTOBER 15, 1984
$3

ElectronicsWeek

Converter fits 1-in.^{2} package

CAN ACCEPT 16 BITS/65

CONSUMER INDUSTRY COOLS IC ARDOR/47



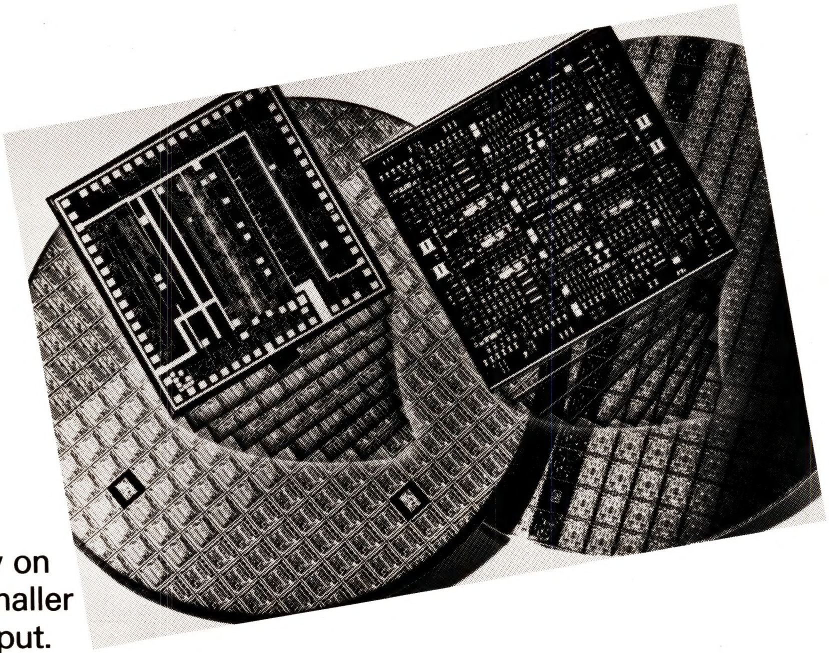
Robot makers clean up their act/11

Growth goal attained, distributor seeks to increase profitability/39

Spectral analysis joins personal computer job list/61

More modern than many large corporations believe:

We invested DM 6 million alone in an electron beam exposure system to automatically produce masks. You could have some of it.



The demands placed on electronic circuits and systems are continually on the rise. Systems must be made smaller and cheaper and deliver higher output. Integrated circuits play an important role in meeting these demands. We have therefore acquired state-of-the-art equipment for manufacturing high-precision integrated circuits.
And we make much more than integrated circuits. Our product range includes opto-electronic modules, transistors, diodes, component groups, film circuits and film touch-control keyboards. We will gladly provide you with detailed information. Please send for our 16-page company brochure today.

TELE FUN KEN

TELEFUNKEN electronic
Creative Technologies

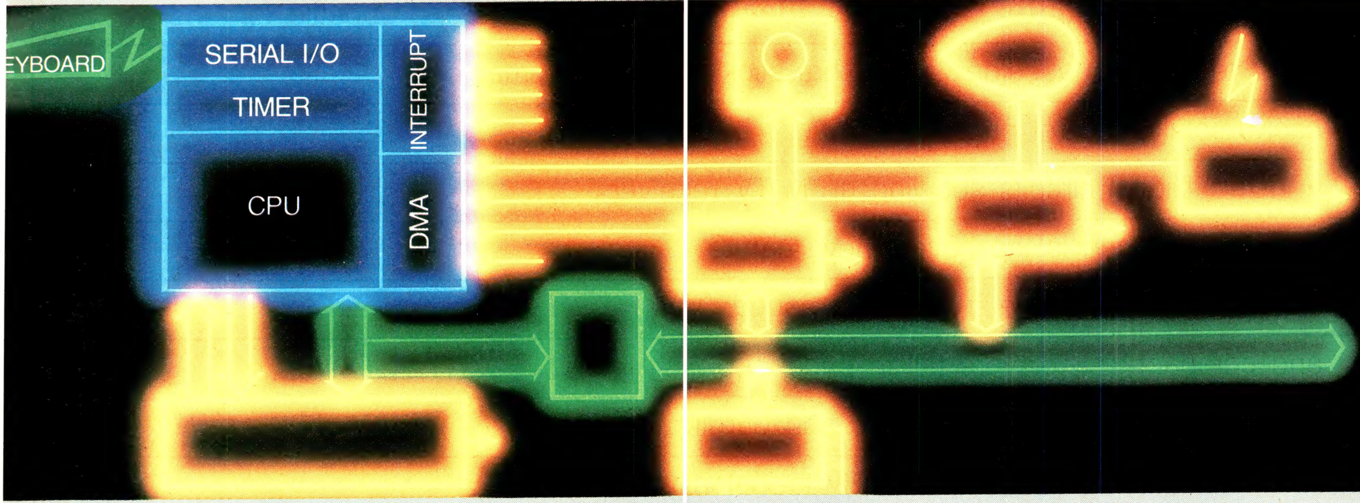
Theresienstraße 2 · D-7100 Heilbronn · Telephone (07131) 882-423 · Telex 728746 tfk d

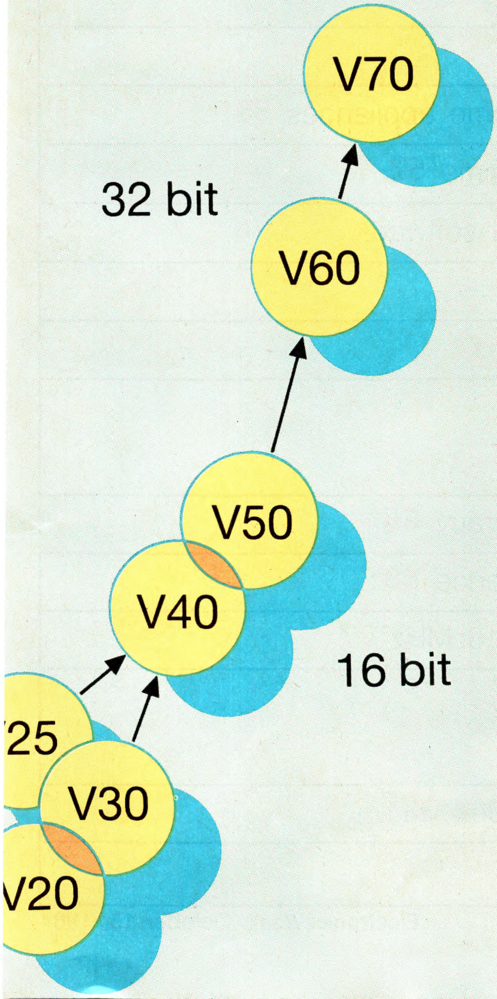
Te. WAK 5004 E

Circle 90 on reader service card

NEC

The next Generation of Micros.





'Totally in CMOS' – this is the best abstract for **the V series from NEC.** In the new microcomputer generation literally everything is implemented in CMOS, the CPUs as well as the peripheral LSIs.

Ascending in functionality and performance the new 16 and 32 bit microprocessors guarantee a growth path without problems. Innovative in architecture they consider the existing standards in hardware and software. They support all the functions required of processor systems for today and tomorrow: high level languages, graphics, spread sheets, industrial controls, just to name a few.

The highly integrated **microprocessor systems V40 and V50** unite the performance of the 16 bit CPUs **V20 and V30** with the necessary peripheral LSIs needed for the systems configuration on one single chip. The results are more functions, higher reliability, and compact implementation, together with convenient costs.

The most important characteristics of the **V series from NEC** are functionality, performance, and ease of application development. They are designed for the end products for tomorrow you are working at today: personal computers and office automation, telecommunications equipment, computer peripherals, CAD/CAM workstations, high performance systems for technical and scientific data processing, automation equipment of all kinds.

With the total CMOS concept from NEC the systems designers becomes as flexible, as his tasks require: peripheral ICs, support units, and memories, all in CMOS enhance the broad range for utilization of the V series even more.

In short, **the new microprocessor generation from NEC** is the best choice for your new products.

The **microprocessors of the V series** come with the proven quality of all NEC products: best reliability due to the highly automated production process, great functionality as a result of innovative design.

Electronics from NEC –
Quality for your Products.

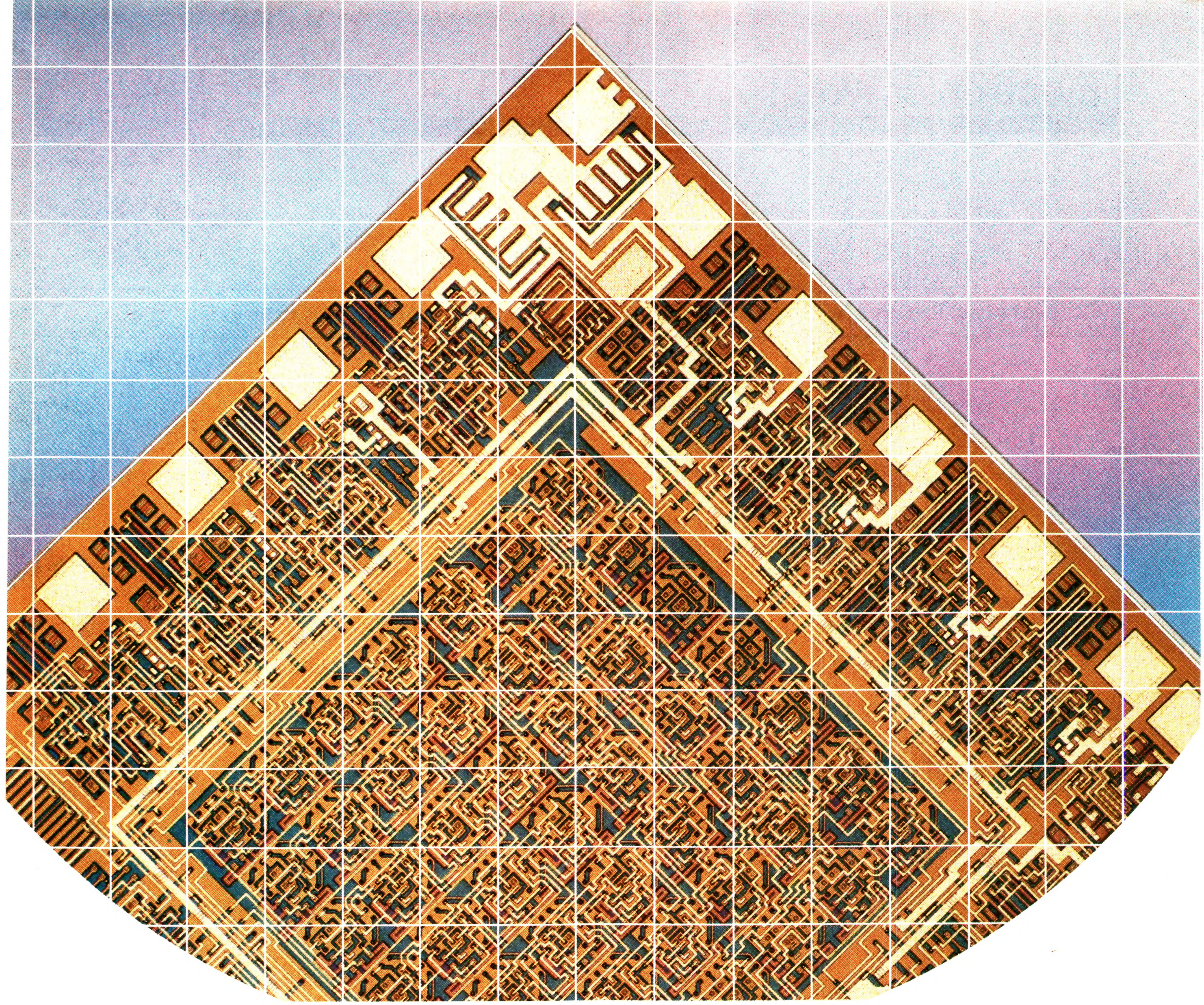
NEC
West-Germany: Düsseldorf 02 11/65 03 01, Telex 8 587 419.
The Netherlands: Eindhoven 0 40/44 58 45, Telex 5 1 923.
France: Paris 01/6 09 90 04, Telex 2 03 544.
Italy: Milano 02/6 70 91 08, Telex 3 15 355.
Sweden: Täby 08/7 56 72 45, Telex 1 3 839.
UK: Motherwell 06 98/73 22 21, Telex 7 77 565.

® electronica 84

Munich, 13.-17. Nov. 1984
Hall 25, Booth 25C58

PRW

Circle 91 on reader service card



ULA*. Gives you the edge for custom LSI.

Thinking custom LSI?

You should be, to gain the edge over your competition.

To get the full benefits of custom LSI you must include not just the system logic but also the I/O and analogue functions.

The ULA is designed to do precisely this by combining the logic implementation, an I/O capability for all commonly used technologies and a facility for integrating functions such as Schmitt trigger inputs, precision oscillators, analogue switches, op amps, voltage references, comparators, high current drive transistors and so on.

The ULA provides the economic and performance benefits of full custom design but with the short time scales of gate arrays.

There are over 50 different ULA's supported by the Ferranti Silicon Design System, the CAD facility covering the complete design cycle from system concept to silicon hardware.

In more ways than one, the ULA gives you the edge.

For further information, contact

IC Marketing,
Ferranti Electronics Limited,
Fields New Road, Chadderton,
Oldham, OL9 8NP.
Tel: 061-624 0515, Telex: 668038

BETTER
BY
DESIGN

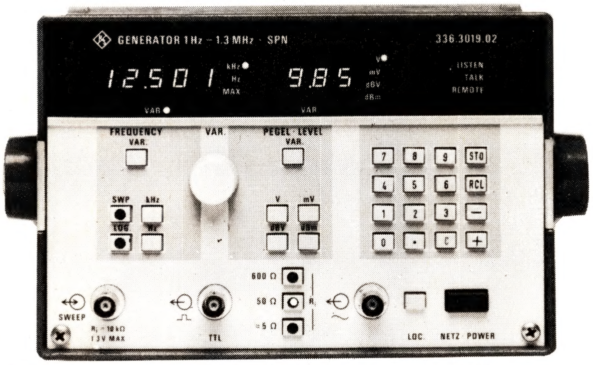
FERRANTI
Semiconductors

Circle 92 on reader service card

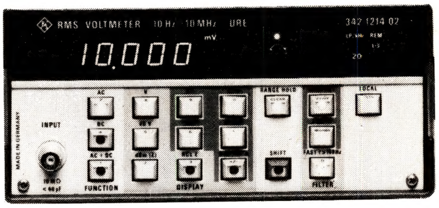
---

* ULA is a registered trademark of Ferranti plc for semiconductor devices.

Small but mighty for lab and service

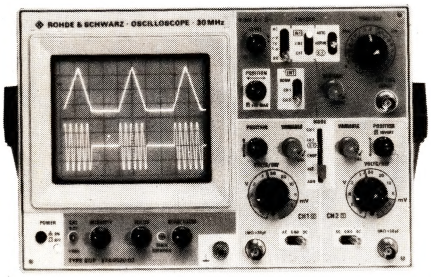


Synthesizer Generator SPN · 1 Hz to 1.3 MHz
Level range 0.1 mV to 10 V. Flat frequency response ±0.5 %; distortion 0.03 %. Input for external reference frequency (1 MHz). Switch-selectable source impedance (5/50/600Ω). Simple, convenient keypad settings; quasi-continuous variation with rotary knob. Full IEC 625-1/IEEE 488 programmability.

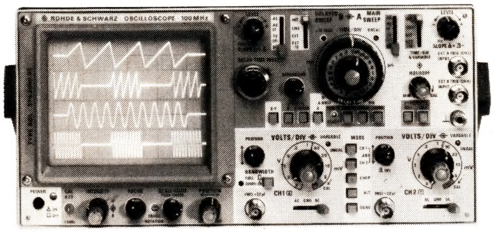


RMS Voltmeter URE · DC to 20 MHz, 4½ digits
The handy unit for lab and systems (optional IEC bus). True rms measurement 50 μV to 300 V (crest factor >5). Many readout functions: dBm, dBV, %, dB. Basic error 0.5 %. Built-in lowpasses 4/20/100 kHz.

Digital Multimeter UDL 33
DC to 20 kHz; 100 μV to 1000 (750) V; 1 μA to 10 A; 100 mΩ up to 20 MΩ. Basic DC error 0.1%. Handy, sturdy, complying with safety standards, 3½-digit LCD with automatic zero setting, polarity and battery indication, 32 measurement ranges. Hi-Ω and Lo-Ω operation, 10 MΩ input impedance in all ranges.



Oscilloscope BOP · DC to 30 MHz (above)
Value-for-money 2-channel scope for production and service. Sensitivity 1 mV/div to 2 V/div, timebase 20 ns/div to 0.5 s/div; deflection error ±3 % (from 5 mV/div). Autotrigger and TV field or line sync triggering. Built-in 1-kHz calibration source. Modes: CH1, CH2, CHOP, ALT, XY, AC, DC, × 10 timebase.



Oscilloscope BOL · DC to 100 MHz (below)
High-grade 4-channel scope for lab and R & D. Sensitivity 2 mV/div to 5 V/div; 2 independent timebases for 2 ns/div to 0.5 s/div; deflection error ±2 %. Autotrigger, variable holdoff, TV field or line sync triggering. Built-in 1-kHz calibration source. Modes as for BOP plus 8-trace display (4 signals and 4 magnified extracts).

Ask for the data sheets.

Rohde & Schwarz GmbH & Co. KG
Postfach 80 14 69
D-8000 Muenchen 80
Federal Republic of Germany
Telex 523 703 (rus d)
Tel. internat. + (49 89) 41 29-1

There are **R & S agencies** in 80 countries.
We plan and supply stationary and mobile systems, also on a turn-key basis.
R & S services comprise installation, maintenance, calibration, training and documentation.

ROHDE & SCHWARZ

Measuring Instruments and Systems · Sound and TV Broadcasting
Radiomonitoring and Radiolocation · Radiocommunications

1 L2 E 08/4

Circle 96 on reader service card

Enter the new era of
MICROSYSTEM DESIGN

MICROPROCESSOR SYSTEMS: Software and Hardware Architecture delivers a wealth of information about microcomputers, peripherals, networks, signal processing and software, that leads the field in the 80's!

This book is a comprehensive collection of technical articles, carefully detailed and presented, in exclusive reprints from *Electronics* Magazine.

Corporate Managers, Project Managers, Design Engineers, Market Managers: **MICROPROCESSOR SYSTEMS: Software and Hardware Architecture** is one book for all!

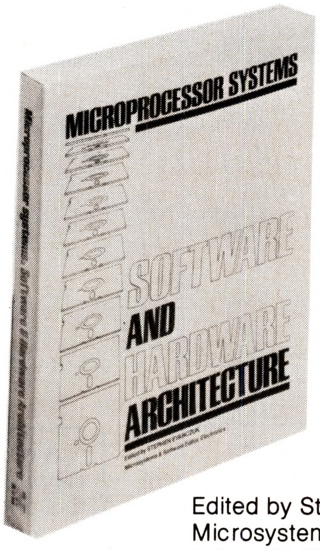
Six knowledgeable chapters examine:

- Significant trends in the development of new software systems and applications
- Technical articles on the manufacture of new microprocessors
- Approaches to memory management used by major chip manufacturers
- Conveniences of peripheral chips
- Alternative network methods from Ethernet to token-passing protocols
- Modular procedures for making digital signal processing systems

Engineers - Save precious time by eliminating a cumbersome series of software instructions.

Directed chiefly at design tactics, **MICROPROCESSOR SYSTEMS: Software and Hardware Architecture** helps you avoid errors and overcome all your architectural problems.

- Brings you the needed simplicity of design, without sacrificing performance of the finished system
- Offers a means of tapping microsystems into the power of mainframe machines
- Recounts major breakthrough in dedicated chips that handle math operations in record time



Edited by Stephen Evanczuk,
Microsystems & Software
Editor, *ELECTRONICS*

In one resourceful volume, **MICROPROCESSOR SYSTEMS: Software and Hardware Architecture** lets you understand:

- Functions of hour end microprocessors and controllers
- Key microprocessors that trigger the personal computer revolution
- The importance of dedicated chips more sophisticated than mainframes of yesteryear
- Significant aspects of microcomputer software
- Efficiency of peripheral-control chips

Here it is --
MICROPROCESSOR SYSTEMS: Software and Hardware Architecture - Let it design for you!

Don't be left in the dark: **MICROPROCESSOR SYSTEMS: Software and Hardware Architecture** illuminates the design process of an ever changing industry.

Don't delay -- order your copy today!

Use the coupon or send in your company purchase order.

MC GRAW-HILL PUBLICATIONS CO.
Attn: ECC
McGraw-Hill House
Maidenhead, Berkshire SL6 2QL
England
(Tel. (0628) 23431; Telex 848640)

Send me ________copy(ies) of MICROPROCESSOR SYSTEMS: Software and Hardware Architecture for $21.95 each. (U.S. residents please include local sales tax).

☐ Payment enclosed (postage & handling included)
☐ Bill me (postage, handling & tax will be added) NOTE: All orders under $30 will be sent a pro forma invoice requiring prepayment.
☐ Bill my company. Purchase order is attached.

Ship to:

Name ________________

Company ________________

Street Address ________________

City__________State________Zip________

Country ________________

McGraw-Hill knows you will be satisfied, but if for some reason you are not, there is a ten-day money-back guarantee that applies on all books.
Allow four to six weeks for delivery.

ROBOTS READY TO TAKE JOBS IN CLEAN ROOMS

Robotics manufacturers are tidying up their existing models and designing new machines for semiconductor production lines

☐ by Wesley R. Iversen

Chicago

Ruggedized robot systems that spray paint, bend metal, weld, and perform other heavy tasks are finding their way into dirty factory environments. But the electronics industry is in need of a cleaner kind of automaton. Not only must the robot perform lighter tasks requiring better precision, but it must also avoid fouling the air in a clean room, where even a small amount of oil residue or airborne particulate can be deadly to product yield.

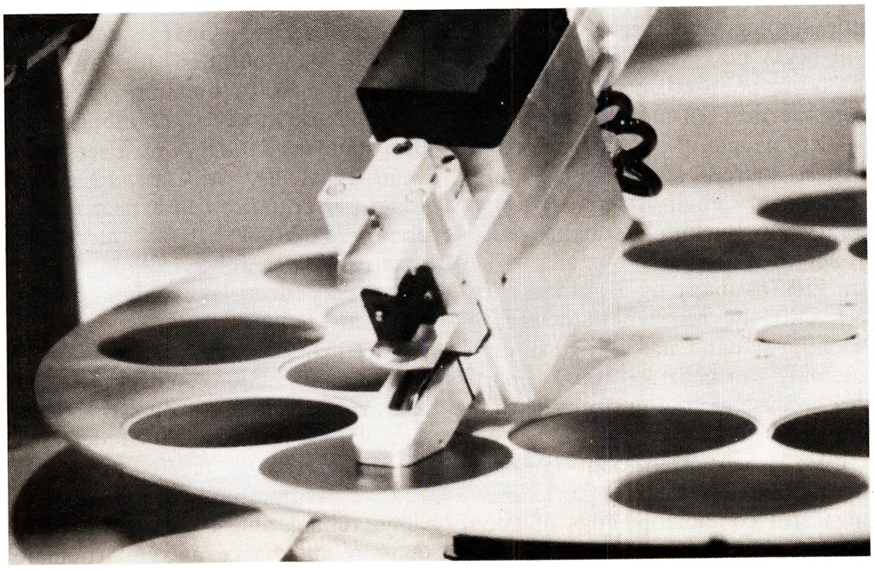
Indeed, as production integrated-circuit geometries move below the 1-µm level, some chip producers are envisioning the day when human beings may be removed from wafer-fabrication areas entirely, leaving critical tasks to cleaner and more predictable mechanical friends. With these requirements in mind, a growing number of robotics manufacturers are busily involved in cleaning up the robots in their existing product lines, while at the same time developing next-generation arms that will be cleaner than their predecessors.

Coming clean. For example, GMF Robotics Corp., Troy, Mich., recently introduced a version of its standard A-O robot that features special rotary seals, covers, use of nonabrasive materials, special paint, coatings, and other steps designed to hold down particulate emissions [*ElectronicsWeek*, Oct. 8, 1984, p. 90]. Others, such as IBM Corp.'s Manufacturing Systems Products unit in Boca Raton, Fla., offer kits that can be used to outfit current-generation robots for clean-room applications. Still others, such as Intelledex Inc., in Corvallis, Ore., have announced projects to develop entirely new robot designs that will meet future electronics industry requirements for cleanliness and efficiency that are more stringent than today's industry standards (see "Joint effort for clean rooms," p. 12).

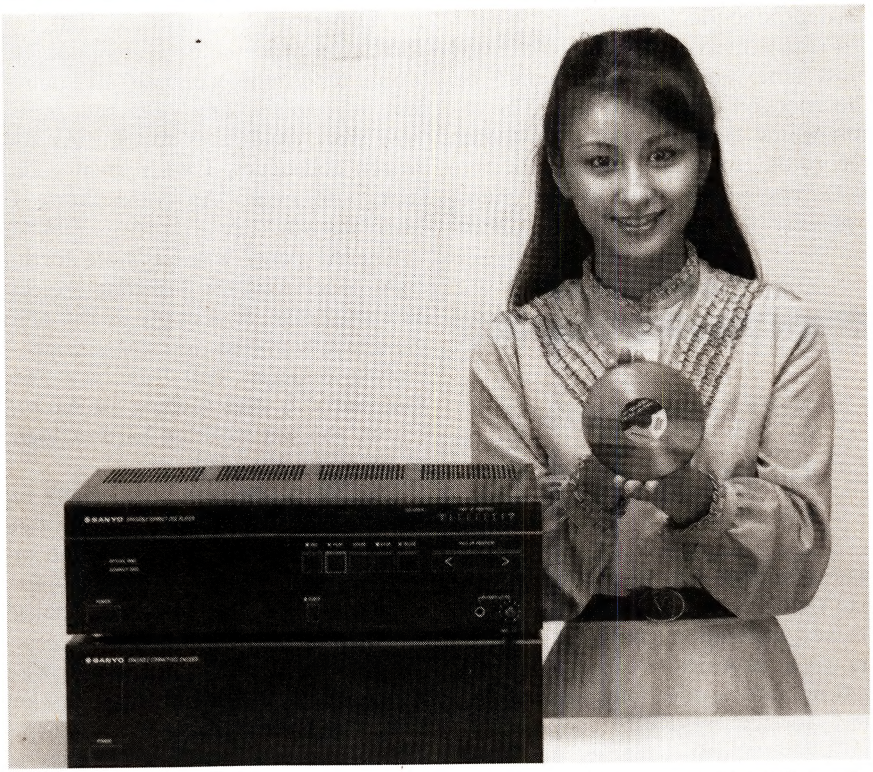
Rooms for tryout. "The trend is clear that more [robot systems manufacturers] are really making an effort in the clean-room area," observes Laura Conigliaro, who follows the industry for Prudential-Bache Securities Inc., in New York. "One amazing thing is that I go to a lot of these companies, and they're all setting up their own version of a clean room so that they can start putting together their systems."

American Robot Corp., Pittsburgh, has already shipped several of its Merlin robots for use in Class 100 clean-room environments to assemble disk drives and handle silicon wafers, says national sales manager Vince Scotti. Within a few weeks, he adds, the company expects to complete its own Class 100 facility to better study the problem, with an eye toward pushing ahead toward Class 10 environments and better as electronics industry needs dictate.

At GMF, Electronic and Semiconductor Business Segment Group manager Dwight Morgan says his firm is already there. Worst-case particulate emission from the White Ro-



Clean-room robot. Rated for Class 100 operation, the Intelledex 605T has a multifunctional end effector that can transfer wafers into and out of the substrate layer.



Spotting a market. Sanyo is first off the mark with home recording equipment for digital audio compact disks, showing its prototype this month at the Japan Electronics Show. Production versions, which will be pared down considerably in size, are several years off.

dable competitor to digital tape recording.

The new home recording medium would have the advantage of avoiding the conflicts associated with standardizing a new recording format. Tape-recorder manufacturers, by contrast, have had a committee studying the problem of standardization since June 1983.

Sanyo, based in Moriguchi City, near Osaka, became the first to declare its intention of building compact-disk recorders, showing a prototype at the 1984 Japan Electronics Show in Tokyo early this month. The work is being done at the firm's development center here and is expected to take two or three more years. Although the experimental model is relatively large and heavy, design refinements and the development of integrated circuits should permit the manufacture of home digital recorders whose quality is comparable to today's studio equipment.

Magneto-optical technology has been chosen to provide both record and erase capability. Kokusai Denshin Denwa Co. pioneered the technology in Japan and licensed it to a number of firms, including Sony Corp. and Sharp Corp. [*Electronics*, Oct. 6, 1983, p. 84].

Hot spots. Writing is performed by heating small spots on the disk's gadolinium-terbium-iron thin film above the Curie temperature with energy from a 20- to 30-mW laser. A magnetic field generated by the writing head reverses the perpendicular magnetization of the spot as it cools. Another beam from the same laser, operating at 2 or 3 mW, reads out recorded signals using the Kerr magneto-optic effect, which causes rotation of the plane of polarization when plane-polarized light is reflected off the polished surface of a strong magnet.

For the sake of compatibility, Sanyo uses the same sampling and coding format as the standard compact disk. However, to overcome a much poorer signal-to-noise level for the magneto-optic disks during playback, it was necessary to increase the disk speed. Maximum playing time is therefore reduced from the 74 min on studio-recorded compact disks to only 30 min. Sanyo engineers expect future improvements in the disk and the recording head to improve the signal-to-noise ratio enough to permit operation of the recorder at the same disk speed as a standard compact-disk player.

Standard compact disks, however, can be played back on the prototype system. Because the disks are normally played back at constant linear, rather than constant rotational, velocity, the drives are able to accommodate a wide speed range. A beam splitter and separate optical detection systems make it possible to pick up signals from either type of disk.

Although Sanyo is the first to announce a potential product, an industry source points out that other firms have similar capabilities. He says Sony, Sharp, Hitachi, and others have shown prototype data disks using magneto-optic technology.

Tape alternative. Digital audio tape, with which the disks would compete, probably won't appear as a commercial product before the spring of 1986. Last June, the Digital Audio Tape Conference selected two format types—one based on stationary heads, the other on rotary heads—for its 70-odd member firms to experiment with for another six months. Even if one or both formats are selected in early 1985, it would take at least a year to develop the integrated circuits needed for a commercial product.

Also, there are differences in sampling rates and tape speeds in the two formats, so it is not a foregone conclusion that agreement will be reached anytime soon. The stationary-head format uses 20 tracks, which the head records in two directions. The other uses a rotary head similar to the one in a video cassette recorder, but smaller.

Selection of the stationary head would facilitate development of walk-around recorders, because the technology requires a relatively small space. But the digital tape cassettes would still be slightly larger than standard audio cassettes, and tape consumption would be fast—about 47.6 mm/s, the same as for "Walkman" recorders. Fabrication of a stationary head requires techniques similar to those used in semiconductor fabrication.

If the rotary head format were selected, it would make for larger recorders, but the cassettes themselves would be smaller, and tape consumption only about 9 mm/s. Also, VCR manufacturers can make the 30-mm-diameter drum and heads using stan-

IBM Corp. that it has made what it labels a major advance in computer speech recognition, some of that suspicion can be dispelled: any development from the giant adds legitimacy to a technology.

Scientists at the company's Thomas B. Watson Research Center here say that their experimental system is 95% accurate and is designed to work in the office for preparing documents such as letters and memos. It can recognize 5,000 words in its basic business vocabulary, although that number can be increased slightly by spelling new words into it.

Modeling technique. "Our recognizer statistically models the essential speech processes involved," says Frederick Jelinek, who heads the IBM speech-recognition group at the research center. "That includes the way the speaker pronounces his words, the way he puts words together to form sentences, and the details of his personal vocal characteristics. The system is not based on rules, nor does it attempt to imitate the way people recognize speech."

One job that the IBM system as now constituted will not be able to perform is speech synthesis. Asked if it were possible to adapt the recognition system, one IBM scientist who is working on the project replies, "No. We tried it and it sounded even worse than the speech-synthesis systems that are on the market."

The system learns to recognize the user's voice after he reads a prepared text once; that process takes 20 minutes, according to the researchers. Once the system is trained, words and sentences appear on a work station screen as the user speaks.

Sources at IBM say the system, based on Fourier analysis, contains an acoustical processor—essentially a vector quantizer with only 200 points—which analyzes the speech, and a linguistic decoder, which translates it into written form. The processor sends out a signal every 10 ms in a time-synchronous fashion. Spoken input is digitized at a sampling rate of 20 kHz/s.

A pattern recognizer compares the result with stored vocabulary, looking not only at pronunciation of individual words but also at context and the user's speech patterns to improve its guess. Thus the system can distinguish between "to," "do," and

News briefs

Philips pushes multiprocessing for VMEbus boards

Glimpsed briefly last April [*Electronics,* April 19, 1984, p. 88] Philips' Distributed Real-time Multiprocessor (DRM) system is now out from under wraps and will be used by the Dutch heavyweight to leverage sales of its 68000-based family of VMEbus boards. DRM, Philips claims, solves both the software and hardware problems of developing multiprocessor systems with from one to several hundred processors. Additional processing power (or fault-tolerance) can be added by plugging in extra processor boards, without totally rewriting the software. That is because the operating software is written independently of the hardware and only maps onto it in the final design phase.

Written in the C language, it is based on a mailbox message system that can pass up to 1,000 messages a second. Development software runs on a Digital Equipment Corp. VAX under VMS. The system runs on standard VME boards, though Philips has also introduced a processor board with interrupt-handling facilities for communications with other processors.

Toshiba to market VHS

Toshiba Corp. will become the first Japanese Beta-format VCR maker to market the rival VHS format in Japan when it introduces two models in December. The Tokyo firm, which began overseas VHS production at its plant in the UK last May for European distribution, plans to turn out 80,000 units monthly at its plant in Fukaya starting this month. But Toshiba says it has no plans to discontinue its Beta-format manufacturing. Industry analysts in Japan expect that the other two Beta makers, Sanyo Electric Co. and NEC Home Electronics, also will begin producing VHS models. VHS holds close to 75% of the world's VCR market.

Compaq sees no weakness in IBM PC-compatible sales

Despite pessimistic forecasts haunting producers of IBM PC-lookalike systems, Compaq Computer Corp. of Houston says sales of its compatible personal computers continue at a record clip. Compaq officials reported last week that third-quarter revenues will exceed $85 million, compared to $36 million a year ago. The figure is also more than $19 million over revenues reported in the 1984 second quarter, but the firm says net income will be only slightly higher than the $892,000 in the three months ended June 30.

Telecommunications spurs fiber-optics growth

Sales of fiber-optic electronics equipment to U.S. telephone companies could reach $1.5 billion by 1988, reports Northern Business Information Inc., New York. Dominating the market, particularly in lasers, are the Japanese suppliers Fujitsu, NEC, and Hitachi, but AT&T Co. is reported to have a strong cost position and can compete aggressively in price. In addition, the U.S. telecommunications giant is said to be developing new fiber-optic technology for use in both data and voice-grade carriers.

Frost and Sullivan Inc., also of New York, predicts similar growth for Europe, as telecommunications needs expand the fiber-optic market at a rate comparable to that in the U.S. The main area for growth there is submarine cables, followed by fiber-optic links in data processing. Markets for optical fibers and fiber-optic connectors and couplers are expected to increase 25% a year.

TI settles class-action suit for $12 million

Continuing to deny that it misled stock investors with an over-optimistic 1983 outlook, Texas Instruments Inc., Dallas, has reached a $12 million settlement in a class-action suit filed a year ago after the firm posted huge losses in the home-computer business. TI, which says the out-of-court settlement will not have a "material effect" on current earnings, has established a $12 million fund for payment of claims to investors trading its stock between March 1 and June 10, 1983. TI stunned Wall Street in June 1983 by announcing expected losses of more than $100 million because of slumping sales of its 99/4A.

bit 8096 for evolving high-end control applications requiring more arithmetic punch. "The market is there today, all right, but the thing is it will take some time for design-ins to result in volumes," promises Joe O'Neill, marketing manager for microcontrollers at Intel Corp., in Chandler, Ariz.

"For 8-bit, it has taken 18 months for design-ins to result in volume. It could take a little longer in 16-bit and so you are probably looking at 18 months to two years before seeing the start of volumes." Meanwhile, Intel has brought up production capacity and yields for its heavy-selling 8-bit 8051 family, for which demand rocketed with the 1983 recovery, says O'Neill. To stimulate further design-ins of this 8-bit family, Intel this month cut their prices 16% to 47%.

Mostek has been selling 8-bit 3870 microcomputers since the mid-1970s and is now targeting its new 16-bit 68200 microcontroller at a wide range of high-speed input/output and computational-intensive applications. "We see it where high-end 8-bit parts run out of gas," comments Richard Lee, branch manager of microcomputers, adding that the 68200—a spinoff of the 68000 microprocessor family—is two to three times faster than the most powerful byte-wide microcontroller.

Still moving ahead. But 8-bit microcomputers are certainly not standing still. Some of the latest entries are discreetly taking on characteristics of 16-bit processing. At the late-October's Wescon show, Motorola Inc. is officially introducing a new high-end 8-bit microcontroller, designated 68HC11, which contains an enhanced set of 16-bit instructions for multiplication and division.

Deep in the heart of the byte-wide controller chip are 16-bit registers that perform higher levels of math in parallel with the 68HC11's 8-bit core, says Steve Marsh, Austin-based manager of strategic planning and marketing for 8-bit microcomputer in Austin, Texas. The strategy is an extension of Motorola's older 6801 8-bit family, which contains a limited 16-bit instruction set.

"Starting about Wescon timeframe and throughout 1985, the 68HC11 will be the cornerstone of our new activity," Marsh states. The chip, which will sell for less than $20 next year in volumes over 10,000, also contains a chip-load of onboard memory and processing-peripheral functions. They include 8-K bytes of read-only memory, 512 bytes of electrically erasable programmable ROM, 256-K bytes of random-access memory, an 8-channel analog-to-digital converter, an 8-bit pulse accumulator circuit, a real-time interrupt circuit, and watchdog circuits to ensure the system is operating properly. To take advantage of the feature-loaded chip, Motorola also plans to unveil at the show a new microcontroller development system, called the HDS-300. It will cost about $10,000 fully loaded.

A slightly different strategy lies behind NEC Corp.'s 7800 high-end 8-bit microcomputer line. Internally, this series of n-MOS and CMOS devices has a 16-bit architecture. But it presents data byte-wide to the system. "I think our parts are more traditional microcomputers with a diverse range of functions rather than having a wide data bus," says Rich Morse, technical marketing manager of single-chip components, based at NEC's Mountain View, Calif., operation. "It all depends on whether you want to sell your device as an intelligent peripheral for 16-bit host processors or as a stand-alone microcontroller." **–J. Robert Lineback**

SPEECH RECOGNITION

One-card system recognizes words in a sentence with 90% accuracy

Meylan, France—Collaboration between a French public research laboratory and a small microelectronic engineering firm has borne fruit in the form of a connected speech recognition system that can be integrated into existing data-processing configurations or used as a stand-alone peripheral. What's more, the inexpensive, single-card voice-input system is wrought in an architecture flexible enough to incorporate future developments in recognition algorithms and software.

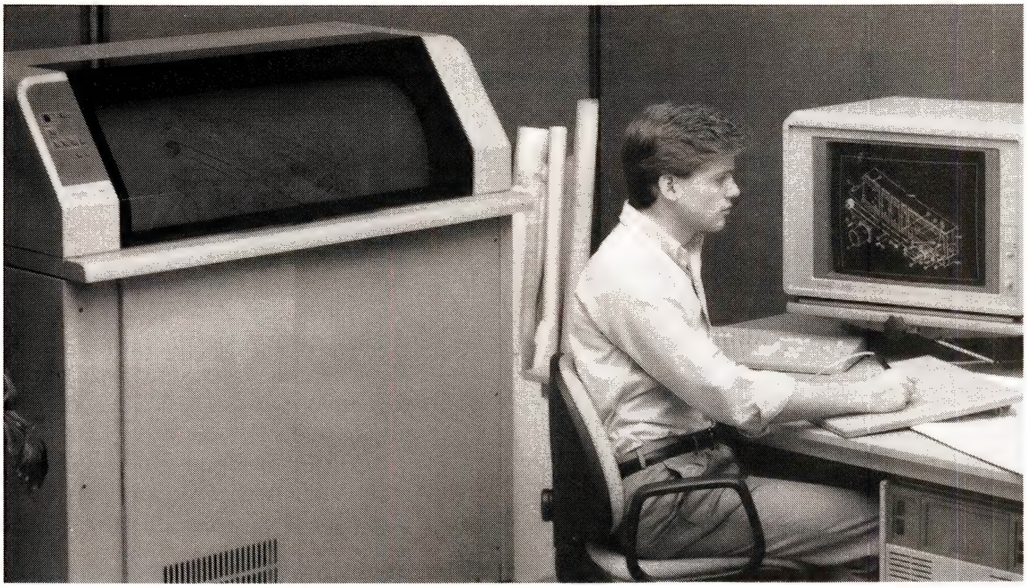
Original research for the system was carried out at the principal research laboratories of the Centre National d'Etudes des Télécommunications in Lannion, Brittany, and centered principally around definition and implementation of the algorithms necessary to recognize about 100 French words connected in sentences up to six words.

When CNET was able to operate the system on its in-house developed Astre computer with average recognition reliability levels of about 90%, it set out to convince Xcom S.A., located in this town near Grenoble, of the feasibility of integrating the entire system on a single printed-circuit board.

The result is that Xcom is about to go to market with a one-card voice input system called Seraphine, a French acronym for automatic recording and recognition system for interpretation and execution of sentences. Seraphine can be integrated into any multibus system for little more than $3,000. Less than $100 more buys a packaged, stand-alone peripheral.

Speaking English. This past summer, Interstate Voice Products, Orange, Calif., introduced its $1,650 VocaLink board, which permits the programming of 240 discrete spoken commands to control IBM Corp. Personal Computer software programs [*Electronics,* June 14, 1984, p. 48]. A more sophisticated board, the VPC 2000 from Voltan, of Fremont, Calif., is able to handle continuous phrases (instead of single words) for a voice-activated telephone-dialing and -answering service; it sells for $2,450. Tecmar Inc., in Solon, Ohio, sells a unit that responds to a 200-word vocabulary and sells for a cut-rate $995.

Seraphine is a speaker-dependent recognition system in that, before use, the operator is obliged to execute a 10-minute training sequence where he pronounces the words in the system's vocabulary. After acous-



Electronic drawing. The Tektronix Inc. 4991S1 uses vector algorithms to convert hard copy into an on-screen display. Drawings can then be tailored for insertion into data bases of CAD/CAM systems.

by 47 in., or E-size). As it rotates, an optical scanner transfers the drawing to the display terminal. More complicated line patterns, such as arcs, circles, and text, can also be transferred and stored on 20 megabytes of hard disk. The display terminal has 2 megabytes of random-access memory for manipulating the drawing once it is transferred.

Usually the transfer takes 90 minutes (redoing a complex drawing manually can take days), and once the graphics are on the screen, the user selects graphic manipulation and structuring functions from on-screen menus. Structuring functions include line straightening, point registration, and semiautomatic arc, line, text, and symbol replacement. Undesirable features caused by smudges, creases, and stains on the hard copy are eliminated at this time. In addition, the user can call attention to specific portions of the drawing by using color tagging or adding alphanumeric annotation.

The 4991S1 represents an important new technology because it does away with raster scanning, according to Sam Gordon, manager of graphic input for the Information Display Group at Tektronix. While he concedes that a raster scan is accurate, Gordon stresses that it has a significant drawback in that it has to process upwards of 10 million bytes of information when each line of a typical drawing is divided into a series of discrete points.

By contrast, vector scan requires less than 200-K bytes for almost the same results since only the end points of the lines figure into the computations. The computations, of course, are more complicated because the location of end points where lines intersect is often ambiguous. Also, some accuracy is lost because there has not been a point-by-point transfer. To mitigate the problem, Tektronix has developed a proprietary algorithm at its Applied Research Laboratory with pattern-recognition capability that can produce usable vector scans in real time.

Contention. Some of Tektronix' competitors, however, are convinced that doing away with raster courts disaster. Jim Taggart, manager of software engineering for Metagraphics Inc., Woburn, Mass., maintains that the problem with vectors is that too many inaccuracies inevitably show up. "A raster drawing is the only kind acceptable for the front end of a CAD/CAM system, because at the other end—where you want to download graphics to a robot or numerical controller—you need point-for-point correspondence [*Electronics-Week,* Sept. 17, 1984, p. 32]. That's more expensive, but it's necessary," he maintains.

Accordingly, Metagraphics has priced its model 2100 drawing converter at about $300,000—about twice as high as the 4991S1—and sees itself as the "front end of a CAD/CAM operation."

But Tektronix believes that vector scan is accurate enough for CAD/CAM, and points to arrangements with IBM Corp., Armonk, N.Y., and Computervision Corp., Bedford, Mass., to convert hard copy for, respectively, CADAM and CADDS4X equipment, as well as for its own TekniCAD system.–**David M. Weber**

MOTOR CONTROLS

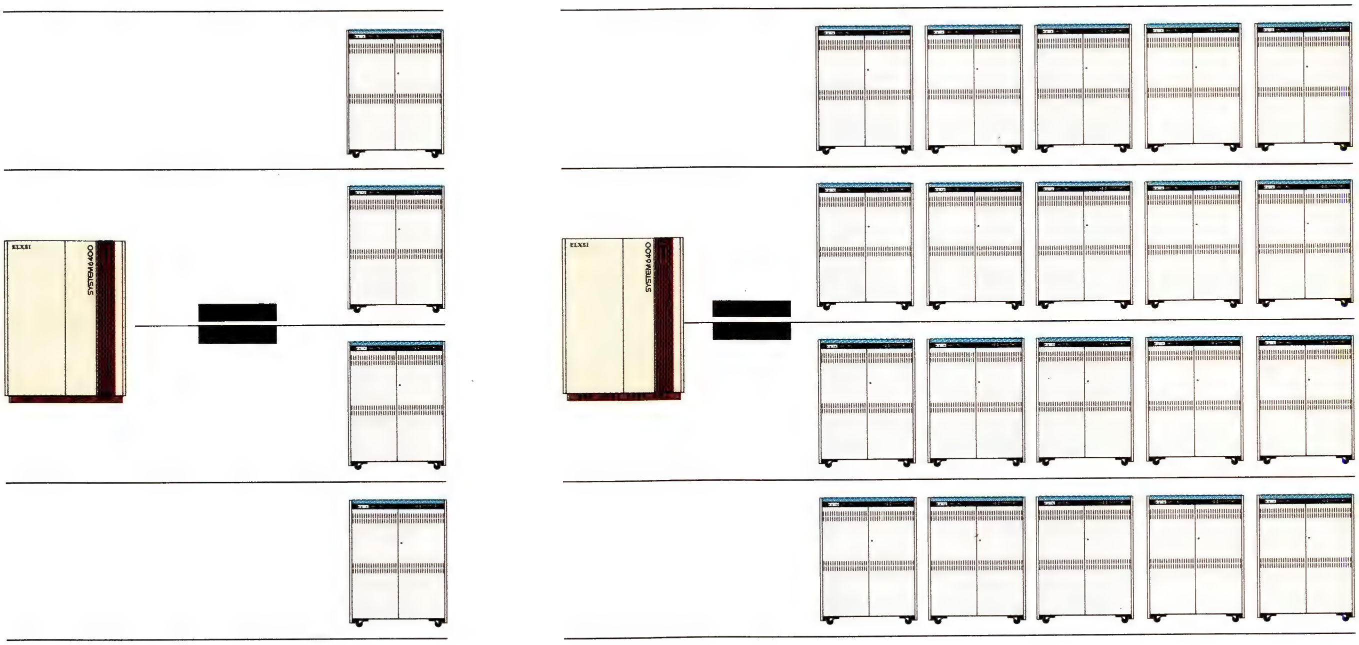
Closed loop starts, runs brushless motor

Boston—Engineers at Imec Corp. they have developed a closed-loop control technique for brushless permanent-magnet motors that eliminates the need for transducers and provides full-torque, reliable starts.

So far, controlling brushless ac motors, which are widely used in military and aerospace equipment, has meant one of two options. One was to build the motors with commutation transducers, which result in increased motor volume, axial length, and more connecting wires. The second option has been to build motors without commutation transducers and control them by monitoring back electromotive force. But this involves open-loop starting, which has its own problems of low torque and stalling.

Donald Fulton, now chief engineer

ELXSI vs. VAX



NOW OR LATER

Unmatched performance, deliverable now, and potential for expansion. That's ELXSI. The ELXSI System 6400 with one CPU has 4 times the performance of the VAX 11/780. Plus you can add up to 5 CPUs in the initial cabinet, and deliver 20 times VAX performance. 10 CPUs in two cabinets. Now. Or later.

The 64-bit multiprocessor System 6400 offers a choice of either EMBOS, our proprietary message-based operating system, or ENIX, our virtual memory UNIX System V operating system. You can choose either one or both. All configurations feature 32, 64, or 80-bit floating point arithmetic hardware, virtual memory, Ethernet link, the largest physical memory in the business, and more.

The ELXSI System 6400. No one can match our performance or our potential. Not now. Not later. Contact ELXSI today for complete information.

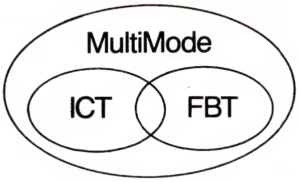
THE ELXSI GUARANTEE:
find a computer system that can match our performance and our potential for expansion, and we'll raise our price to match theirs.

ELXSI

ELXSI, 2334 Lundy Place, San Jose, California 95131
408/942-1111, Telex 172320.

UNIX is a trademark of Bell Laboratories. Ethernet is a trademark of Xerox Corporation. VAX is a trademark of Digital Equipment Corporation. EMBOS and ENIX are trademarks of ELXSI.

Circle 21 on reader service card



Combining in-circuit and functional test techniques in one system. That's the secret of MultiMode.

MultiMode really is a case where the total is more than the sum of the parts.

This integration is what makes us so certain your yields will improve. MultiMode lets you apply both testing techniques in a single, comprehensive test program to find faults at the most effective level—device, cluster or board.

It's a strategy that stops faults from slipping through undetected. It's based on efficient programming, and on efficient diagnostics. Together making sure you get the highest levels of fault coverage as fast as possible.

And using MultiMode testing on a single powerful machine lowers work-in-process inventory buildups around separate testers. Reduces board handling. And increases throughput.

With higher test quality, more efficient programming, and lower operating costs, the L200 actually lowers lifecycle testing costs for modern VLSI boards.

And that's money in the bank for you.

A Brilliant Deduction.

It's a proven solution. MultiMode testing delivers yield advantages on modern VLSI boards. More than 100 machines are already demonstrating this every day. For manufacturers of personal, mini and mainframe computers, telecommunications switching systems, avionics, and other advanced high tech products.

The L200 costs more than other testers out there. But it's worth it. Using MultiMode, your staff will get high fault coverage faster than ever before. And give you yields at system test that can save you millions.

It all adds up to one thing. Call Teradyne today, (617) 482-2700. Or write Teradyne, 321 Harrison Avenue, Boston, MA 02118.

TERADYNE

We measure quality.

Circle 23 on reader service card

aggressive and the most coordinated," observes ICT president Drew Allen Osterman.

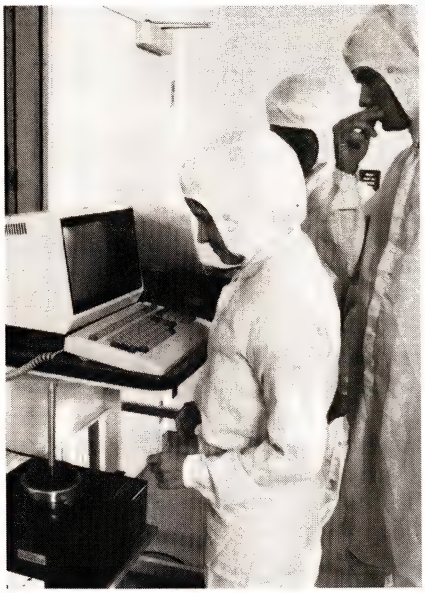
Besides ICT, which will put up Indiana's first merchant IC plant, Sony Corp., Tokyo, recently announced plans to build a $15 million to $20 million laser-video-disk-replication plant in Terre Haute that is expected to employ 250 [*Electronics,* June 28, 1984, p. 54]. That commitment was made following a pledge by Indiana state officials to abolish unitary taxation from its corporate tax laws (unitary taxation has been a source of concern to multinational firms based in Japan and elsewhere).

Digital Audio Disc Corp.—a subsidiary of CBS Inc. and Sony—already has a compact-audio-disk pressing plant in Terre Haute, which turned out its first product last month. The first to press compact audio disks in the U.S., the plant will employ about 100 in its initial phase.

The first part available from ICT will be conservative: a 1-K serial electrically erasable programmable read-only memory built in 3-μm technology. Samples are scheduled for shipment in January. But with its second product, ICT will get more aggressive, says Osterman.

"We expect to be the first U.S. producer to have a 64-K CMOS EPROM in production," he declares. That chip will be fabricated in 2-μm technology, and its production is scheduled to start during the second quarter of 1985.

Future plans call for the introduction of four more CMOS parts within ICT's first year, including a unique programmable part that will go beyond current-generation programmable logic array parts by allowing inputs and outputs to be individually programmed, Osterman says. Other products planned for the Indiana operation are a 64-K EEPROM, a 16-K nonvolatile random-access memory, and a 64-K static RAM. –**Wesley R. Iversen**



High-tech neighbors. Ahead of ICT, Digital Audio Disc Corp., owned by CBS and Japan's Sony, brought clean rooms to Indiana.

FOREIGN TRADE

Brazil squeezes auto makers

São Paulo, Brazil—Brazil's Special Secretariat for Informatics—which so far rules supreme in all things digital—has taken on and beaten such heavyweight opponents to its policy of total Brazilian ownership of computer technology as IBM Corp. and Burroughs Corp. Now the Secretariat has come up against no less an adversary than the automobile industry, in the form of local subsidiaries of Fiat, Mercedes-Benz, Scania, and Volkswagen, not to mention Ford, General Motors, and others.

The new confrontation is over the question of microelectronics in motor vehicles, a key issue in Brazil's export-oriented auto industry. The manufacturers, all strongly committed to Brazil as an export base, want to introduce the latest technological developments, which include the integrated circuits that control fuel injection, carburetor fuel-to-air ratio, and other functions.

But in doing so, they run up against Brazilian government policy, which states that, wherever possible, digital equipment should be produced by local companies with all their capital in the hands of Brazilian nationals. Col. Edison Dytz, the head of SEI, puts it this way: "Both we and the Ministry of Industry and Commerce have a policy whereby the car manufacturers should not verticalize their production, but rather take advantage of outside suppliers on the Brazilian market. That means, in digital equipment, companies with 100% Brazilian capital."

So far, says Dytz, the only company to have approached him with a concrete proposal is Ford do Brasil S.A. The project, for electronic fuel injection systems on the Escort, has been accepted. That is because, says Agostinho Gaspar, Ford Brazil's director of government and public relations, the company's technology will be transferred to a firm that is completely Brazilian in its capitalization.

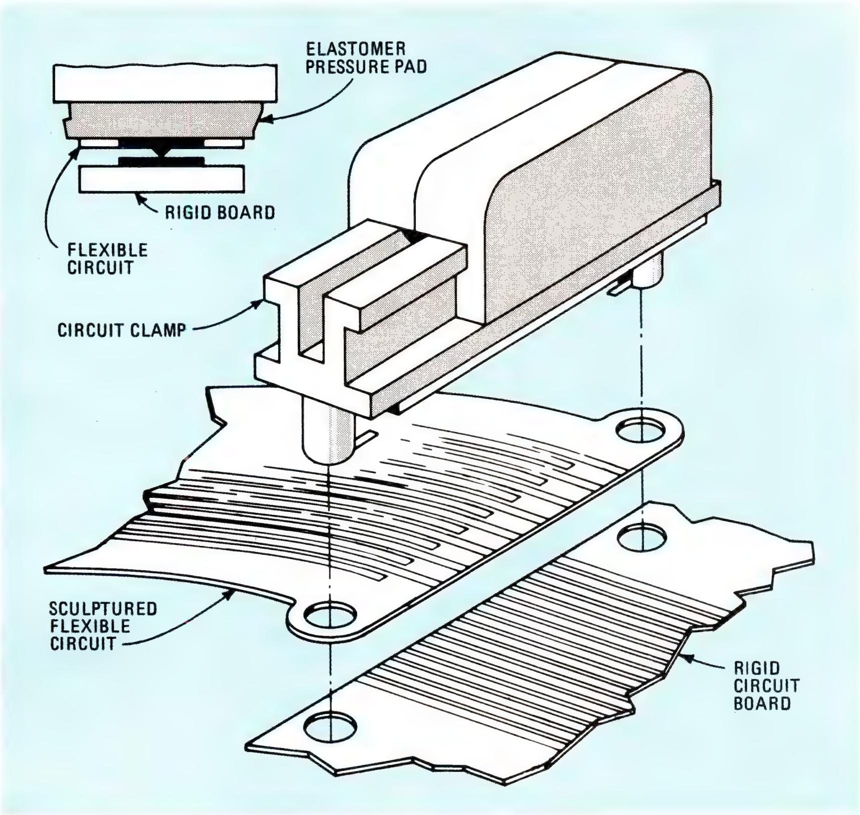
Ford is clearly the company that has gone furthest in seeking an agreement with the SEI, perhaps because it also suffered the worst setback. Last year, it was obliged by the SEI's policies to sell off a plant earmarked for digital-chip manufacturing. The plant, at Contagem in the state of Minas Gerais, had absorbed joint Ford and RCA Corp. investments totaling $30 million since 1979 but was sold off to local capital for a mere $9 million.

GM bides its time. General Motors do Brasil S.A. has no proposal before the government. According to Eduardo Antonio Vilela Feijó, supervisor for project engineering, GM is awaiting a clearer definition from the SEI as to who should present the project, whether the car manufacturer or the auto-part manufacturer.

The decision is complicated by SEI's nationals-only policy and the fact that a number of companies do not want to transfer technology. "In fuel injection, for instance, Bosch has world-class technology for automated systems and has a Brazilian subsidiary, but they've already declared that they're not interested in licensing that technology to anybody else down here," says Feijó.

In the U.S., GM uses a fuel injection system from one of its subsidiaries, but it can't bring this technology to Brazil. An alternative is to use a different fuel injection system that could be supplied by Bosch. But this also runs up against SEI regulations, a Catch-22 with no solution in sight.

Volkswagen do Brasil, however, has a wide range of microprocessors in its Voyage and Paraty models, for which it has received special permission from SEI to import parts, explains VWB economist José Rocha de Almeida. The firm already has a Brazilian version of the Voyage with



Keeping it simple. The SNAP fastener uses the printed-circuit board as one contact surface, the flexible circuit as the other. Both are tin-lead coated over their contact area, although gold-plating can also be used if the connection is to be regularly broken.

sion, now in the works, will probably only suit sculptured circuits, says Brian Shorrock, managing director of Dowty Electronic Components Ltd. Both firms are divisions of the Dowty Group plc, a general engineering and avionics company.

The process can also be used to form high-spots or dimples on the flexible circuit. In addition, SNAP can be used with traditional flexible circuits by forming dimples in the elastomeric pressure pad.

Shorrock maintains that the SNAP connector is inherently more reliable than traditional one- or two-part edge connectors or insulation-displacement connectors with ribbon cable, because there is only a single high-integrity contact interface instead of two or three, as in one- or two-part connectors. In addition, there is no contact wear when a connection is made.

Aside from reliability, SNAP has other advantages, says Shorrock. It will be 60% cheaper than equivalent insulation-displacement connectors, can be mounted anywhere on the pc board's surface, and takes 20% of the volume. The technology is being further developed with lower-profile and higher-density versions in the works, as well as a thick-film hybrid version.

–Kevin Smith

OPERATING SYSTEMS

MITI picks Unix over IBM system

Tokyo—AT&T Bell Laboratories Unix operating system, which has been struggling against IBM domination in the Japanese market, has won a potentially significant victory. When Japan's Ministry of International Trade and Industry begins its five-year $300,000 project to develop a new system for the mass production of software next April, the basic operating system will be Unix.

MITI has yet to make the official announcement, but sources close to the project say its budget request has been approved by the Finance Ministry and will be submitted to the next Diet session in early December. It is expected to pass.

Though MITI officials deny it, Japanese fear of IBM market domination is at least one factor behind the choice of AT&T's Unix for this project. Other reasons include the failure of the Japanese to develop a suitable operating system and the perceived need to move as quickly as possible to reduce the manpower costs of software production. At present, an estimated 90% of Japanese software development tasks are performed manually; one goal of the project is to reduce that to 80%.

Modification necessary. AT&T's first task is to modify its system. "We're Japanizing Unix, adding kanji [Chinese character] capability," says John W. Cusick, managing director of AT&T International Japan Ltd. He expects the kanji standardization to be completed by the end of the year, to be followed by feedback modifications from Japanese makers and finally a formal licensing agreement for the software production project with the government.

A new group, the Information Technology Promotion Agency, has been organized under MITI control to administer the project. After AT&T provides the basic operating system software, four Japanese partners—Fujitsu, NEC, Hitachi, and Nippon Telegraph & Telephone Public Corp.—will donate staff to add telecommunications and data-processing capabilities.

AT&T, which claims 125 Unix licensees plus 20 agreements with original-equipment manufacturers in Japan (its largest market outside the U.S.), is hoping that the MITI project work will lead to Unix becoming the industry standard for operating systems. The company added a software licensing operation (Japan Unix Systems Ltd.) to its Tokyo office in July and plans to have 13 Japanese software engineers on staff by next spring. Unix's ability to interface with various operating systems is considered a strong point in AT&T's efforts to break into Japan's value-added-network market, which is expected to grow quickly once liberalizing measures take effect next April.

The emerging Information Network System, a massive, multibillion-dollar national digital communications network, is another target of

Because we deliver what our customers need to compete. Worldwide!

The density of your choice

High speed ROMs in all densities, including NMOS EPROM replacements, and standard COBs for all computers on the market. And CMOS ROMs are on the way!

The quality you specify

Specify quality levels of 250 PPM today. Expect 100 PPM tomorrow. We design quality and testability in — for inherent reliability.

The quantity you need

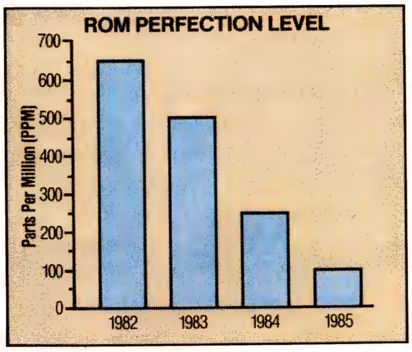
No order is too large. Our minimum order is 2500. It's common for General Instrument to fill million-piece orders.

The delivery you want

Fast turnaround is assured with LAMP,™ late mask programming, large wafer banks and production facilities on three continents.

Design flexibility you expect

Our ROM family, fully adaptable to firmware, offers the expansion capabilities you need for present and future product designs. Examples: VariPage™ programmed paging options; FlexSelect™ programmable options for Chip-Select requirements; custom COB design capabilities, complete turnkey cartridge services, and many other options.



ROM PRODUCT PORTFOLIO

PART NUMBER	DESCRIPTION	PIN SIZE	ACCESS TIME (ns)	EPROM COMPAT	ADDED FEATURES
R0-3-9316B/C	2K x 8	24	450,350	2716	
R094132B/CS/C	4K x 8		450,350,300	2532	
R09432B/CS/C/DS/D	4K x 8		450,350,300, 250,200	2532	
R09433B/CS/C/DS/D	4K x 8			2732	
R09464B/CS/C/DS	8K x 8		450,350,300, 250	68764	
R09864B/CS/C/DS/D	8K x 8	28	450,350,300, 250,200	2764	
R09128B/CS/C/DS/D*	16K x 8		450,350,300, 250,200*	27128	FlexSelect™
R09256B/CS/C/DS/D*	32K x 8			27256	
*R09512	64K x 8		< 300	JEDEC	VariPage™
*R091000	128K x 8				
*ROC128B/CS/C/DS/D	16K x 8		450,350,300, 250,200	27128	CMOS FlexSelect™
*ROC256B/CS/C/DS/D	32K x 8			27256	
*ROC512B/CS/C/DS/D	64K x 8			JEDEC	CMOS, FlexSelect™ with VariPage™
*ROC1000B/CS/C/DS/D	128K x 8				
SPECIALTY ROMs					
R094P64	8K x 8 2 x 32K Banks	24	450	2532	Page ROM
R094P128	16K x 8 4 x 32K Banks				
R09540	4K x 10	28	N/A	N/A	On chip address latch
R09580	8K x 10				
R09120	12K x 10				

*For Future Release

CHIP ON BOARD (COB) PRODUCT PORTFOLIO

PART NUMBER	DESCRIPTION		ACCESS TIME (ns)	ADDED FEATURES
COB59764	64K COB	for Atari VCS	450	Page ROM/Std Part
COB607128	128K COB	for Colecovision		General Instrument Std Board Design
COB60964	64K COB	for VIC-20		
COB609128	128K COB			
COB61064	64K COB	for Atari Computers	350,300	
COB610128	128K COB			
COB62564	64K COB	for Radio Shack Color Computer		
COB625128	128K COB			
COB63464	64K COB	for C-64		
COB634128	128K COB			
COB63964	64K COB	for MSX		
COB639128	128K COB			
COB63664	64K COB	for IBM PC Jr.	250	
COB636128	128K COB			

For the density, quality, quantity, delivery, and flexibility you need, call the nearest Microelectronics Division Sales Office — and we'll deliver our ROM Leadership for you.

We help you compete®

GENERAL INSTRUMENT

Sales Offices USA: CA, 213-322-7745 or 408-496-0844; **GA,** 404-476-0274; **IL,** 312-981-0040; **IN,** 317-841-9328 or 219-291-0585; **MA,** 617-938-5890/91; **MD,** 301-269-6250; **MN,** 612-894-1840; **NC,** 919-828-0317; **NJ,** 201-254-5024; **NY,** 516-933-3379; **TX,** 214-934-1654; **EUROPE: London,** Ruislip, (8956), 36141; **Milano,** (2) 5062648; **Muenchen,** (89) 956001; **Paris,** (1) 374-1133; **Stockholm,** (8) 679925; **ASIA: Hong Kong,** (5) 434360; **Osaka,** (06) 323-1877; **Seoul,** (2) 744-8543; **Singapore,** (65) 235-8030; **Taipei,** (2) 914-6234; **Tokyo,** (3) 437-0281

Circle 29 on reader service card

modeling, whether you are executing familiar technical tasks or dabbling on the edge of engineering exotica, you'll run out of practically everything before you run out of VAX software.

MAINSTREAMING THE TECHNICAL PROFESSIONAL.

VAXstation 100 workstation terminals can be configured with ease. Whether you network them via Ethernet throughout a hierarchy of VAX/VMS systems, or cluster several around a single processor, communications remain streamlined. Each station can access the full range of VAX information management and office automation tools. In this way, the data and programs in general company use can be incorporated into technical projects. Conversely, the highly technical results in a single applications window can be mainstreamed throughout the corporation.

VAXstation 100 workstation terminals let you and your co-workers share and swap information readily. Extrapolate results quickly. Draw conclusions confidently. They rescue the technical professional from tiresome commuting between single-function workstations. They declare war on errors and lost time attributable to manual conversions.

This is the state-of-the-art in distributed computing. VAXstation 100s will not just help project managers increase productivity some day – they will do so immediately.

DIGITAL'S COMMITMENT TO THE WORKSTATION MARKET.

The first add-on workstation terminal for VAX systems, the VAXstation 100 is also the first in a family of new workstation products from Digital. Each reflects Digital's dedication to providing integrated computing solutions.

The workstation terminal provides a truly comprehensive and cost-effective way to coordinate the work of engineers, scientists and researchers. It is unmatched in its ability to accommodate the fluid and unpredictable nature of highly technical projects. And it does so elegantly, whether in response to a momentous change in direction or to a momentary change of heart.

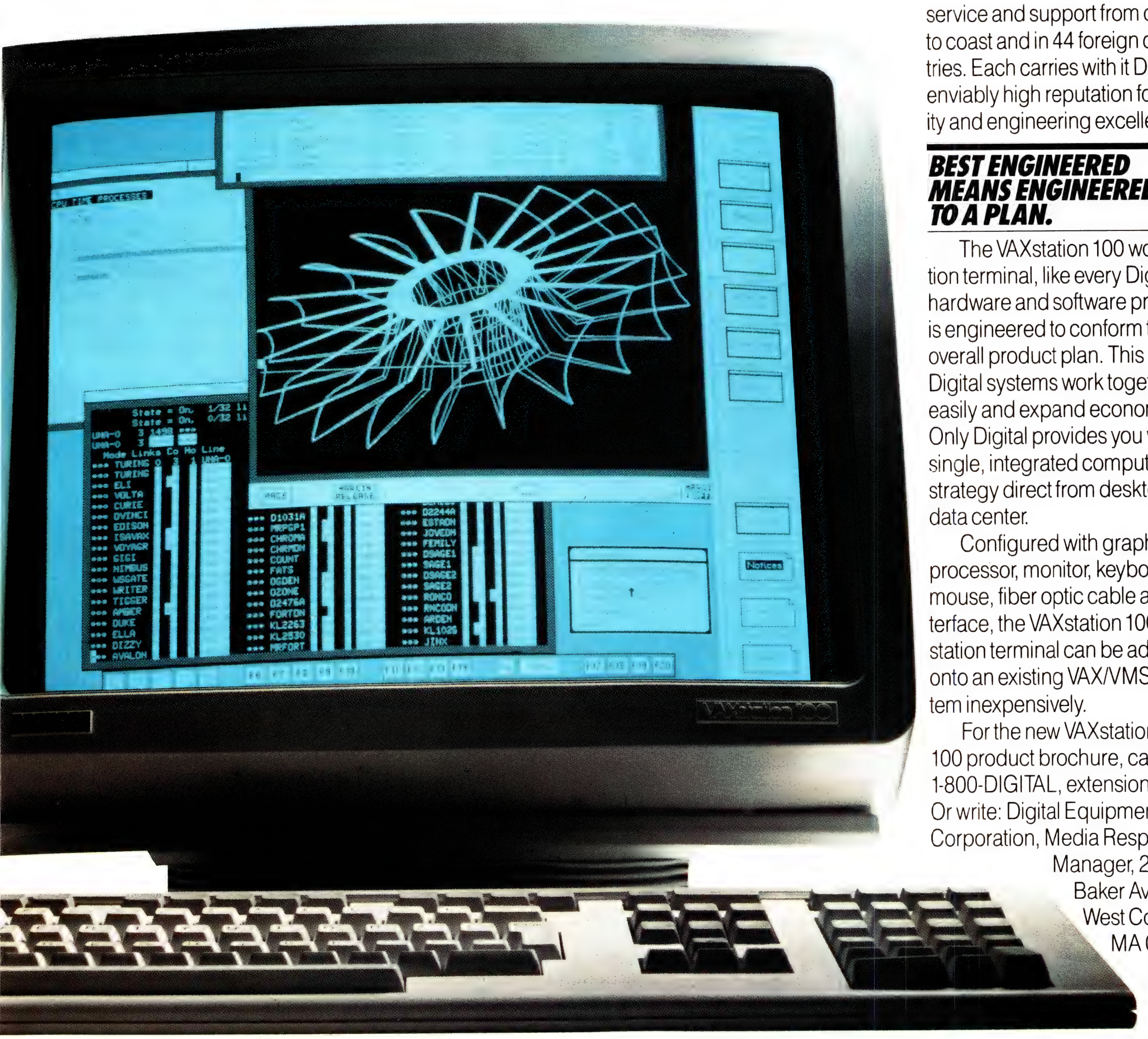
Each VAXstation 100 system comes backed by full Digital service and support from coast to coast and in 44 foreign countries. Each carries with it Digital's enviably high reputation for quality and engineering excellence.

BEST ENGINEERED MEANS ENGINEERED TO A PLAN.

The VAXstation 100 workstation terminal, like every Digital hardware and software product, is engineered to conform to an overall product plan. This means Digital systems work together easily and expand economically. Only Digital provides you with a single, integrated computing strategy direct from desktop to data center.

Configured with graphics processor, monitor, keyboard, mouse, fiber optic cable and interface, the VAXstation 100 workstation terminal can be added onto an existing VAX/VMS system inexpensively.

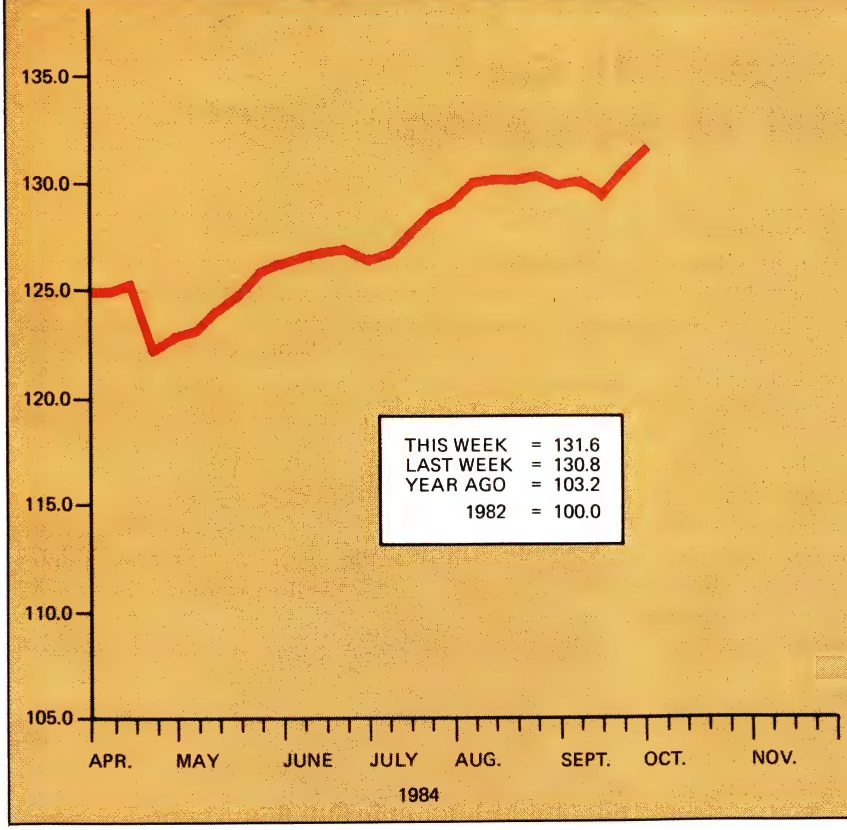
For the new VAXstation 100 product brochure, call 1-800-DIGITAL, extension 250. Or write: Digital Equipment Corporation, Media Response Manager, 200 Baker Avenue, West Concord, MA 01742.



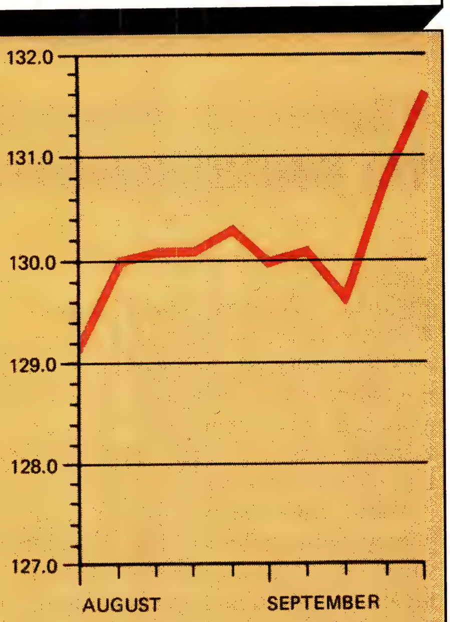
THE BEST ENGINEERED COMPUTERS IN THE WORLD.

digital™

ElectronicsWeek Index



THIS WEEK = 131.6
LAST WEEK = 130.8
YEAR AGO = 103.2
1982 = 100.0



The *ElectronicsWeek* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear below from week to week.

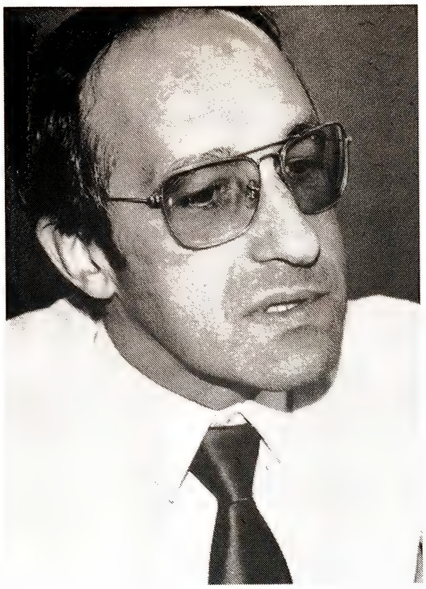
U.S. ELECTRONICS INDUSTRY SHIPMENTS

Shipments ($ billions)	August 1984	July 1984	August 1983
Communications equipment	4.670	4.360	3.665
Radio and TV receiving equipment	0.948	0.930	0.690
Electronic and electrical instruments	4.701	4.883	4.145
Components	3.935	3.814	2.993

U.S. GENERAL ECONOMIC INDICATORS

	August 1984	July 1984	August 1983
Index of leading economic indicators	164.5	163.7	158.9
Budgeted outlays of the federal government ($ billions)	88.707	68.432	67.160
Budgeted outlays of the Department of Defense ($ billions)	20.059	18.870	18.548
Operating rate of all industries (% capacity)	81.2	81.2	76.2
Industrial-production index	166.2	165.8	151.8
Total housing starts (annual rate in thousands)	1,537	1,763	1,873

An increase in shipments of most electronics equipment helped push up the *ElectronicsWeek* Index. The largest gain was in shipments of communications gear, which bounced back 7.1% in August after a July decline. Shipments of instrumentation equipment were weak, however, down 3.7% in the latest period. A sharp rise in outlays by the Defense Department also helped to move the Index up.



Builder. Lino Rolo will be guiding the expansion of product at Brazil's Itautec, including superminicomputers and peripherals.

Formation Inc., Mt. Laurel, N.J.

The project is a qualitative as well as quantitive change for Itautec, Rolo explains. Not only will it mean adding about 600 employees to the current workforce of 1,800 people, but it will also require a change in marketing, technical support, and maintenance for the company, which to date has offered the market only low-end computers.

"Our machine will be known as the I9000," he explains, adding that, after three years, the company will launch another, more powerful supermini already being developed with hardware consultancy from Formation. The reason for this strategy, according to Rolo, is that "the F4000 is, in its largest configuration, equivalent to an IBM 4331, and is software-compatible with System/370 architecture, but we felt that three years from now we'd need to have a new generation of machines to offer the market."

Short-sighted. In this respect, Rolo is critical of the Brazilian companies that, in 1977 and 1978, brought in minicomputer technology under similar reserved-market-share rulings by SEI. He says that their mistake was not developing machines for the next generation, so they are now stuck with outmoded technology. "They didn't complete the cycle of development-manufacture-development as we're aiming to do."

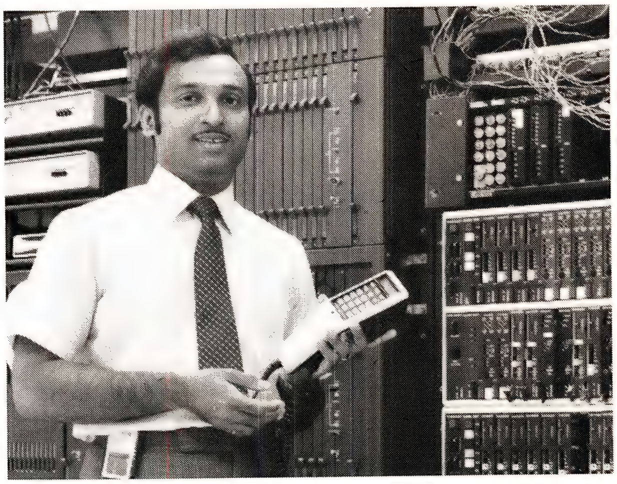
Rolo says that Itautec also plans to enter the peripherals market, which to date it has preferred to leave up to original-equipment manufacturers. "In 1985 we'll be putting 5-in. floppy disks and thermal printers of our own on the market," says the Itautec director. **–Rik Turner**

McGraw-Hill World News

Brody works to increase utility of cellular telephone service

Richardson, Texas

With the first cellular-radio systems becoming operational in a handful of U.S. cities, two-way talk is beginning to fill the airwaves between telephone subscribers. George Brody at Bell-Northern Research Inc.'s cellular laboratory here is exploring new ways to make cellular a better path for conversing computers and the network's own digital switching equipment.



Looking ahead. With cellular telephone barely commercial, George Brody is directing Bell-Northern's work on computer conversation and digital switching.

"Data always follows voice," notes Brody, director of carrier network software development in the lab. The 36-year-old native of Quilon, India, is heading up work on the DMS-250 and DMS-MTX cellular-radio equipment sold by Northern Telecom Inc. of Nashville, Tenn. Bell-Northern is the research and development arm of Northern Telecom, which is teamed with General Electric Co. in U.S. cellular markets.

Brody received his bachelor's degree in electrical engineering from the Indian Institute of Science, Bangalore, in 1968. After working a year as a systems engineer in India's Space Research Organization, Brody began work on graduate degrees at the University of New Brunswick, Canada, where he received an MSEE and MS in computer science. In 1973, he joined Bell's laboratory in Ottawa, where he began development of digital switching systems.

In 1980, Brody went to work at Siemens Corp. in Boca Raton, Fla., to manage digital-switching products, but two years later rejoined Bell-Northern as part of a new R&D group based here. The lab employs about 200 scientists, engineers, and support personnel.

Brody, who presented a paper on the future of cellular radio at the National Communications Forum '84 in Chicago this September, believes the transmission technology will make its way into a number of new applications. These include virtual private networks, which can link a corporation's offices nationwide, and confined networks, for hooking up a single building or campus.

In addition to the technical issues, a major challenge facing cellular-radio system developers, says Brody, is finding agreement on the standards that will expand the use of systems. Although the industry is now widely backing set protocols for voice communications in mobile and portable handsets, manufacturers are not yet agreeing on the next critical steps.

The next step at Northern Telecom is to introduce remote switching features. Remote switching will allow cellular operating companies to more efficiently handle inter-system callers by eliminating the need to send calls back to a central cellular switch. It can also be used to extend service to remote areas. **–J. Robert Lineback**

Nobody likes mistakes. That's why Teradyne has spent more than 20 years building automatic test equipment that roots out and eliminates errors.

Nobody's perfect, however, and in one of life's great ironies, even Teradyne products sometimes fall down on the job.

But not to worry. We can be absolutely candid about this for two reasons. First, we know that within any reasonable framework, Teradyne equipment performs superbly.

Second, when the inevitable problem does occur, we also know that you can't find better service than ours anywhere. And we're very proud of that.

Only Teradyne offers such a variety of service options. For instance, you can contract for complete on-site service to be delivered within a specified time. If we don't come through, you don't pay.

Or you may choose to be more self-reliant, in which case we'll analyze your needs and help train and equip your people to handle almost anything that comes up. You'll go from downtime to uptime in no time.

The point is, whichever option you choose, we'll give you all the support you need. And in this unpredictable world that kind of assurance can be very comforting.

So there you have it. Admitting we're not perfect may be a bit unusual, but then at Teradyne we never follow the pack.

We lead it.

TERADYNE

We measure quality

Circle 37 on reader service card

WITH MARKET POSITION SECURE, ARROW FOCUSES ON PROFITABILITY

Melville, N.Y.

During the late 1970s, Arrow Electronics Inc. implemented a strategy designed to make it a national industrial-electronics distributor, second only in sales to industry leader Avnet Inc. But before the strategy succeeded, Arrow had to endure a tragic hotel fire that killed 13 of its executives who were attending a December 1980 strategy meeting.

In terms of market share, Arrow's performance since that time has been a success. Ranked 10th in the electronics distribution business in 1971, Arrow has held the second place since 1979. With 1983 sales totaling $566 million, Arrow garnered 9.7% of the market, according to San Francisco analysts Hambrecht & Quist Inc. But net income—$5.1 million in 1983—remained well below most of its major competitors.

Shift in emphasis. This has not gone unnoticed by industry watchers, who have detected changes in Arrow's strategy. "I think there has been a shift in emphasis at Arrow," says Clarke Walser, an industry analyst with the Chicago Corp. "More attention is being paid now to profitability," he feels.

ELECTRONIC DISTRIBUTORS MARKET SHARE

Company	Market share (%)	
	1983	1982
Avnet Inc.	19.8	18.8
Arrow Electronics Inc.	9.7	8.8
Schweber Electronics Corp.	6.3	5.0
Pioneer=Standard Electronics Corp.	5.3	4.0
Kierulff Electronics Inc.	5.3	4.5
Hall-Mark Electronics	4.7	3.7
Wyle Electronics Marketing Group	4.4	3.4
Premier Industrial Corp.	3.6	4.1
Marshall Industries	2.9	2.1
Bell Industries Inc.	2.5	1.9
Top Ten	64.5	56.0

SOURCE: HAMBRECHT & QUIST INC.

The convulsive recession that hit the electronics industry in 1982 resulted in Arrow's posting a loss of $1.07 a share. Much of that loss can be explained in part by the costs involved in the firm's move into the lucrative Los Angeles distribution market and the acquisitions there of Computrend Inc. and Computer Products Supply Co. during an industry recession.

Walser notes, however, that Arrow has also worked to become more cost-efficient, particularly in distribution. He thinks Arrow can be more profitable by reducing its debt-to-equity ratio to a more moderate level.

"One thing they've done well is recognize the importance of computers and the importance of going national," agrees another distribution industry analyst who asked not to be identified. Indeed, Arrow is spending $7 million annually on computer-based distribution run by Electronic Data Systems Inc., Camp Hill, Pa.

And in September, Arrow stepped up its drive for cost efficiency by breaking ground for a $10 million, fully automated distribution center in Yaphank, N.Y., not far from its Electronics Distribution Division here. The 60,000-ft^2 facility, to be fully operational by early 1986, will be designed to handle electronic components and computer products and allow Arrow to triple the amount of inventory it carries for East Coast customers.

"It's a good move," points out Everett T. Meserve, senior management consultant for the market research firm Arthur D. Little Inc. of Cambridge, Mass. Automating inventory "should be on the menu for any distributor," he says.

Stephen Kaufman, Electronics Distribution Division president, says the system will use high-speed order-picking cranes controlled by $600,000 worth of computers purchased from Digital Equipment Corp., an Arrow supplier. The system will also include computerized conveyor tracking and cathode-ray tubes throughout the center, says Kaufman, who was brought in from from Midland-Ross Corp., Cambridge, Mass., in August 1982 to run the distribution division.

Arrow has been part of the trend toward equipping regional sales offices with terminals instead of expensive local warehouses, says Meserve. Kaufman maintains that Arrow has led the industry with its electronic sales offices, which he claims enable it to effectively serve smaller markets without the need to stock a warehouse with $400,000 to $500,000 worth of parts.

An advantage of this system is that as second-tier markets in cities such as Portland, Ore. and Seattle grow, Kaufman explains, they can be converted to branch offices. Arrow did this in Huntsville, Ala., last year.

Semicustom due. Like a number of its competitors, Arrow is moving cautiously into semicustom integrated circuits, with three design centers going on line this year. "We're not as enthusiastic as some of our competitors," says Kaufman. At this point, "it's unclear that we are going to make a profit on it. That always makes us nervous."

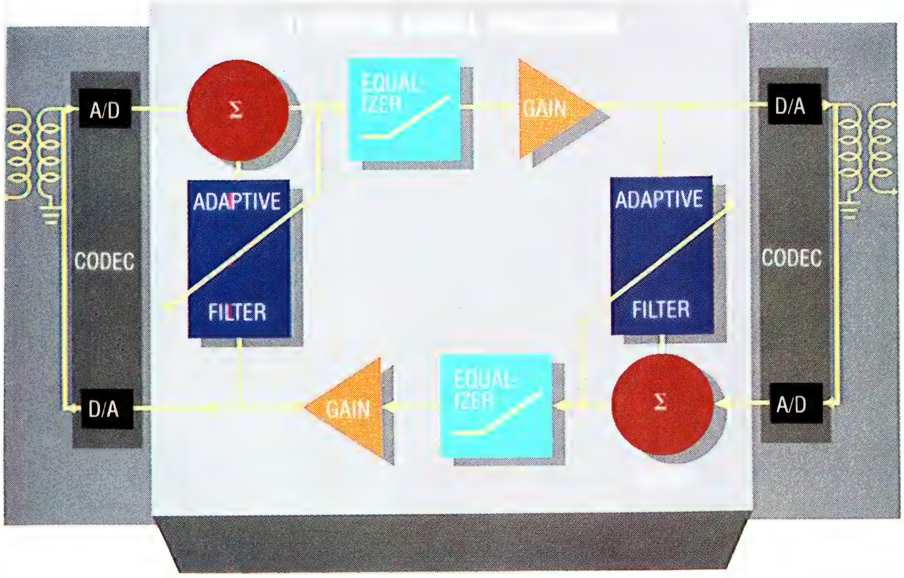
Although Arrow appears highly leveraged, some think it will remain profitable at least during the current boom. Earnings per share have risen steadily, and are currently at $1.27 a share. Assuming the current expansion of the entire electronics industry continues, Walser predicts that Arrow's earnings per share could reach $2.60 by year-end and $3.50 per share by the end of 1985.

Kaufman says management has revised downward its 1984 sales projec-

Texas Instruments digital signal processor helps Lear Siegler Inc. make your message loud and clear...from anywhere.

- **TI's single-chip, high-performance TMS32010** digital signal processor (DSP) assures highest quality telephone transmission (*Page 2*).
- **TMS320 DSPs from TI** support high-speed and numeric-intensive applications from communications to seismic processing (*Page 3*).
- **Complete development support** for TI digital signal processors includes hardware, software, documentation, and application workshops (*Page 4*). ▶

signal processor squelches in unique adaptive repeater.



Heart of the adaptive repeater is TI's single-chip, 16/32-bit TMS32010 digital signal processor. All the functions shown are achieved in real time through software operating on signals digitized by conventional single-chip codecs.

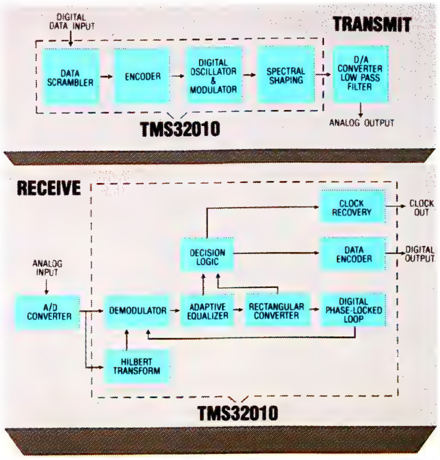
The TMS320 family from Texas Instruments: "Workhorse of digital signal processing."

The TMS32010, first member of the TMS320 DSP family, is TI's trailblazing contribution to an important new technology. A Lear Siegler engineer who has been following the progress of digital signal processing from its inception says, "The TMS32010 is the first device that can reliably do what we need. It's a real workhorse: The '8080' of DSP."

TI's TMS320 DSPs excel at high-speed, numeric-intensive applications

High-performance TMS320-family DSPs from Texas Instruments will find widespread use in many fields where large volumes of high-speed computation are required. In telecommunications, they can also be used to build high-speed modems with data-transmission rates up to 9,600 baud. They can make speech recognition, analysis, and synthesis practical. Speed image processing and pattern recognition. Facilitate high-speed process control and instrumentation. Process radar, sonar, and seismic signals. And furnish the multiple functions often required for a single application.

For example, a TMS320 DSP could enable an industrial robot to synthesize and recognize speech, sense objects and their orientation, and perform mechanical operations through digital servo-loop computations.



High-speed modem functions are effectively performed by TI's TMS32010, as well as such expanded functions as auto-dial/answer, dial-tone verification, busy-signal detection, and self-test routines.

The TMS320 family, with its extensive development support (*see page 4*), can handle all the signal processing for spectrum analysis: Autocorrelation, windowing, fast Fourier transforms—performing a 64-complex-point FFT in only 550 µs. And for seismic processing involving very low frequencies which only a digital system can implement.

Image enhancement, pattern recognition, and data compression are all possible with TMS320 processors. They can extract features and perform template comparisons for optical character recognition.

A one-chip alternative to bit-slice processing

TI's 16/32-bit TMS320 DSPs offer an inexpensive alternative to multichip bit-slice processors. They combine the flexibility of a high-speed controller with the numerical capability of an array processor—on a single chip, in one 40-pin DIP.

Highly pipelined architecture and a comprehensive instruction set give the TMS320 the speed to execute five million instructions per second with 32-bit precision: More than fast enough, for example, to handle the 40 additions and 40 multiplications necessary for realtime voice-frequency processing within the 125-µs sampling interval. A conventional microprocessor, operating at 8 MHz, would require 900 µs, and quickly become bogged down in the signal stream.

Now in three versions

The TMS32010 microprocessor has 288 bytes of on-chip data RAM, and can address up to 8K bytes of off-chip memory at full speed.

The TMS320M10 microcomputer is identical to the TMS32010, but it also includes 3K bytes of on-chip mask-programmed ROM.

The military version, SMJ32010JDS, is processed to the extended temperature range requirements of MIL-STD-883B.

To learn more about the many applications and available development support for TMS320-family DSPs, return the coupon on the following page.

See back page for more information.

Circuits.
Circuits.
Circuits!

Electronic Circuits Notebook.

344 pp., illus.

Some 268 proved-in-action circuits are gathered here for the first time in a single, easy-access resource that meets the highest standards of performance, cost reduction, and reliability. From amplifiers to voltage regulators...from data conversion to phase lock loops ...you'll find the most needed, most reliable solutions to a vast range of circuitry challenges.

Circuits for Electronics Engineers.

396 pp., illus.

More than 340 circuits from all over the world are arranged here by 51 of the most important functions designers use to implement their systems, including amplifers, detectors, memory circuits, integrators, and much more. Complete with component values, circuit diagrams, waveshapes where applicable, and clear explanations of operations and applications.

Design Techniques for Electronics Engineers.

370 pp., illus.

The best of *Electronics'* popular "Engineer's Notebook," this is an indispensable storehouse of solutions to numerous frequently encountered design problems. You'll find a host of proven techniques to help you make measurements, interpret data, make calculations, choose materials, control environment, lay out and purchase components, and more!

Electronics Week Books
P.O. Box 541
Hightstown, N.J. 08520
(Tel.) 609/426-5070

No. of Copies	Title	Price
______	Electronic Circuits Notebook	$17.95
______	Circuits for Electronics Engineers	$17.95
______	Design Techniques for Electronics Engineers	$17.95
______	Microprocessors and Microcomputers: One-chip Controllers to High-end Systems	$18.95
______	Microelectronics Interconnection and Packaging	$15.95
______	Practical Applications of Data Communications: A User's Guide	$17.95

If after my 10-day free-trial examination I am not fully satisfied I understand that my payment will be refunded. Payment must accompany orders under $25.

☐ Payment enclosed ☐ Bill firm ☐ Bill me

Charge to my credit card:
☐ American Express ☐ Diners Club
☐ Visa ☐ Master Card*

Acct. No. ______ Date Exp. ______
*On Master Card only, first numbers above name ______
Name ______ Title ______
Company ______
Street ______
City ______ State ______ Zip ______
Signature ______ ELV

Discounts of 10% on orders of more than 10 books.

— Circle 44 on reader service card

Get Something Straight!

ACU-RITE linear position encoders.

Get higher accuracy than rotary encoders and lower cost too, with ACU-RITE® linear position encoders by Bausch & Lomb. They provide position feedback directly—eliminating errors resulting from the wear and backlash inherent in any lead screw. And because they're simpler, they cost less.

Add value to your design with machine-shop proven ACU-RITE linear position encoders. Ideal for machine tools, electronics manufacturing, quality control, or any precision positioning and measurement application.

And let Bausch & Lomb put its many years of expertise in optical metrology applications to work for you with full engineering support during design—starting now.

CALL BOB CRICK AT 716-483-2585 FOR STRAIGHT TALK!

Or write Bausch & Lomb, P.O. Box 3050, Jamestown, New York 14702

★ ★ MADE BY ★ ★
BAUSCH & LOMB
FOR THE WORLD
TM

ACU-RITE leads the way.

BAUSCH & LOMB

4A025

Circle 45 on reader service card

Ever notice how some people always seem to have the right answer? No matter what the situation, they always seem to be a step ahead.

And they're successful...the first in line to lead an important project...the first in line for a promotion. It's certainly not magic. Usually it's a combination of hard work, brains, guts and desire.

It probably means they read ElectronicsWeek... regularly.

ElectronicsWeek has helped propel many a manager and engineer to the front line...to the "leading edge" of the industry. And just as we've been providing many of your colleagues with the right information, the *important* information–when they need it most–so too can we provide it for you.

Every week an ElectronicsWeek subscriber receives an issue crammed with the latest information on new products, developments, concerns and trends in the worldwide electronics industry.

When you become a subscriber, we'll supply you with the intelligence you need to make the big decision, or the every day decision to further your career and reap profits for your company. For a taste, just browse through the issue you're holding.

But, you really don't have to believe us. Just ask the person who's always a step ahead.

To become a subscriber, just complete and mail the insert card in this magazine. If subscription card is missing, write: Circulation Manager, ElectronicsWeek, P.O. Box 511, Hightstown, N.J. 08520.

ElectronicsWeek
The Voice of the industry

SPECIAL REPORTS

CONSUMER AREA PLANS TO SHIFT MARKETING AIMS

Manufacturers' appetite for latest technology subsides as buyers prefer proven methods, usefulness, and durability

The frenzy over advanced technology that overtook the consumer electronics world in the early 1980s died down in 1984. In its place came a wait-and-see attitude, as manufacturers tried to figure out precisely what it offers their customers. Their focus is shifting from a strategy of packing as much new technology as possible into their products to a realization that most consumers are not buying for technology alone. This is not to say that innovation has suffered. But the consumer electronics industry has been chastened, over the past year, by the experiences of personal computer and video game manufacturers, who discovered that there is no profit for them if the user cannot apply a product to everyday life or becomes bored with it.

Some manufacturers, such as Matsushita Electric Corp. of America, Secaucus, N.J., and Zenith, are expected to introduce digital sets in the U.S. early next year. But others, including General Electric Corp., Fairfield, Conn., and RCA Corp., New York, have postponed their digital product entries, citing a desire to be sure of offering digital sets with performance levels equal to or better than those of their analog counterparts.

Sony Corp., Tokyo, is planning to introduce a 13-in. analog monitor that can be upgraded with an external noninterlace digital scan converter to provide enhanced vertical resolution and eliminate horizontal line flicker. Its main application will be to display data from personal computers, but Sony engineers emphasize that it will also work with a tuner to display a standard TV picture. In addition, Sony is bringing out a 25-in. digital receiver that will boast a horizontal resolution of up to 350 lines for an over-the-air signal and of 450 and 640 lines for composite video and red-green-blue input, respectively. Scheduled release in Japan is Oct. 21.

8-mm video arrives

Whether digital TV takes off or peters out, one video business that looks almost certain to stay hot next year is in video cassette recorders. Indeed, at 3.9 million units, U.S. VCR sales through the first eight months of 1984 were nearly equal to the total sold during all of 1983, itself a record sales year. With the 1984 holiday buying season still to come, the EIA's Consumer Electronics Group predicts that U.S. VCR sales will hit 7 million units in 1984 and climb to 8 million in 1985.

Consumers will also have a new video format to consider, as 8-mm camcorders (one-piece camera and recorder) are scheduled to hit the stores, bearing the names of Kodak, Polaroid, Sanyo, and perhaps others. Matsushita is already shipping 5,000 to 6,000 units per month on a private-label basis to Eastman Kodak Co., Rochester, N.Y., which is marketing the systems for $1,800 to $2,100 under the Kodavision name. Polaroid, likewise, is planning to sell its Toshiba-made 8-mm one-piece camcorder late this year.

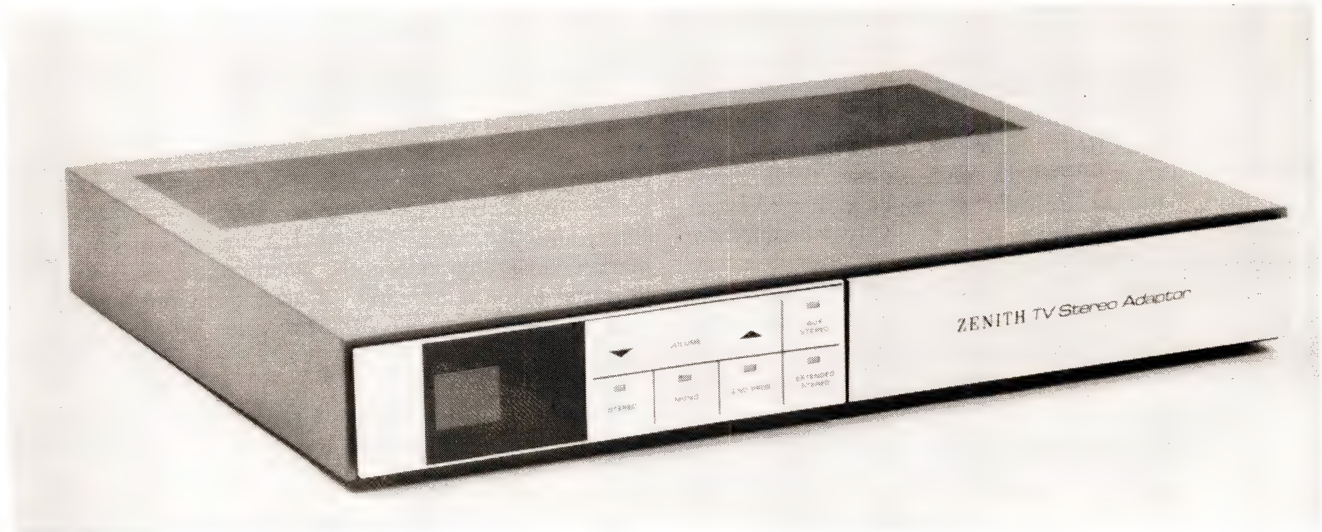
Although Matsushita, for one, says it may display its 8-mm units at the Winter Consumer Electronics Show in Las Vegas in January, the firm maintains the position that it won't yet market 8-mm equipment under its own name. The same goes for Toshiba and Hitachi Ltd., Tokyo; Hitachi has been named the supplier of an 8-mm prototype bandied about by RCA at last January's show. RCA has since backed away from the 8-mm market, as has GE. Although GE still may enter the market in time for the 1984 holiday buying season, the firm postponed an earlier announced 8-mm rollout, claiming head-to-tape compatibility problems with its Matsushita-made unit, a charge that Matsushita denies.

While other Japanese manufacturers hold off on marketing 8-mm units under their own brand names for fear of stunting the boom in conventional ½-in.-tape-based formats, Sanyo Electric Co. Ltd., Moriguchi City, is taking the plunge. The firm is scheduled to begin exporting Sanyo-brand 8-mm units for sale in the U.S. this month. Some observers say the firm could be the first manufacturer to show a stand-alone 8-mm deck without a built-in camera at Winter Consumer Electronics Show.

Despite the presumed advantages of small size and portability offered by the 8-mm format, most manufacturers of the current VHS and Beta ½-in. standard formats maintain that 8-mm will remain a specialty item for the near term at least, constrained by a lack of prerecorded tapes, record times of only 90 minutes, and high price. What's more, the ½-in. stalwarts contend, 8-mm does not offer any tangible advantage over the ½-in.-tape camcorders that hit the U.S. market this year.

Sony, developer of the Beta format, says that sales of its Betamovie camcorder are running strong. Its VHS counterpart, known as Video Movie, is also doing well, with reported product shortages expected to be alleviated before year-end.

Although about the same size as first-generation 8-mm camcorders such as the 5.3-lb Kodak unit, Betamovie and VHS Movie do have some limitations. The 5½-lb Betamovie unit uses a standard Beta cassette, but the current in its rechargeable battery is insufficient to record long tape, and the unit also lacks in-unit playback capability. Video Movie, which weighs in at 4.2 lb, relies



Stereo TV. As broadcasters add stereophonic audio, consumers can upgrade existing sets to receive it. Zenith Electronics Corp.'s Stereo TV Adaptor plays stereo sound through the set's speakers, external speakers, or a home stereo system.

Hi-fi video. Manufacturers of VHS-format video cassette recorders, such as this General Electric Corp. VCR, are racing to provide high-fidelity audio. The high proportion of households with color TVs is fueling the demand for VCRs.

tronic disk technology last April, leaving only Pioneer Electric Corp. as a major U.S. consumer hardware supplier with its LaserDisc technology.

The EIA's Consumer Electronics Group projects that U.S. disk player sales will drop by 27% this year, to only 225,000 units, and to fall further to about 100,000 units next year. But in Japan, where both the laser-based format and Japan Victor's capacitance-based video high density (VHD) format are on the market, manufacturers are expecting slow but steady growth. Projected sales for both disk formats have gone from 200,000 to about 240,000 units for 1984—with sales split about evenly between VHD and laser-based players. More than 800 titles in the VHD format and 1,000 in the laser disk technology are available in software on the Japanese market.

In the U.S., about 900 titles are on the market on conventional 12-in.-diameter disks for Pioneer's laser-based players. In efforts to spur the business, the firm introduced a new 8-in.-diameter disk format last June, with about 100 titles—primarily music video—promised by year-end.

Other steps by Pioneer include the introduction of a $250 interface adapter to be available this fall. It will allow consumers to interactively link a LaserDisc player with a home computer using the disk's random-access memory.

In another move to marry laser disks to an up-and-coming technology, Pioneer Video, Montvale, N.J., plans to combine laser video and digital audio in a high-end product to be introduced at the Winter Consumer Electronics Show. The unit will play laser video disks in both 8-in. and 12-in. formats as well as high-fidelity digital audio material recorded either on the video disks or on a standard compact audio disk. **–Wesley R. Iversen**

AUDIO

VCR acquires high-fidelity sound and compact-disk players fall in price

A further industry trend toward the integration of electronic home entertainment systems is the use of video cassette recorders for high-fidelity audio recording and playback. Sony Corp., Tokyo, began the move about a year and a half ago with its Beta Hi-Fi, and another Tokyo firm, NEC Corp., followed several months behind. Since then, manufacturers of the more popular VHS-format recorders—RCA Corp., Jensen Electronics Inc., Zenith Electronics Corp., Matsushita Electric Corp. of America, and Pioneer Electronic Corp.—have inaugurated their own versions of high-fidelity audio, with or without video accompaniment.

From a marketing standpoint, the integration of video with audio is eminently logical. Close to 80% of European and North American households already have color TV (the figure is even higher in Japan), a situation that will continue to fuel the demand for VCRs. Indeed, VCR sales in the U.S. for 1983 were up about 100% over 1982 and are expected to hit 7 million in 1984, compared with 4 million in 1983. VCR units will probably be found in 50% of all U.S. households by 1990.

Thus, while there is room for all the current players in today's VCR market, the inclusion of hi-fi audio capability is an important—and strategic—feature, both for the consumer, who gets an upgrade to his audio system along with new video equipment, and to the manufacturer, who can increase the appeal of his products by offering it.

It is also noteworthy that the inclusion of audio high fidelity does not add significantly to the production costs of a VCR. The system, in either Beta or VHS format, is based on frequency modulation of the high-frequency carrier, which TV and VCR already use for their audio signals. FM signals are relatively immune to interfering noises, so costly noise-protection circuitry does not have to be built in.

VHS versus Beta

According to most experts, the audio in either VCR format sounds about the same; even a practiced ear would have trouble differentiating VHS's high fidelity from Beta's. But they do work differently.

In Beta Hi-Fi, the FM carrier is recorded onto the video tape simultaneously with the video signal, using the same set of rotating heads. The VHS technique, by contrast, uses separate audio heads on the video head to

Sinjou: The man behind the compact disk

As happens with many technical innovations, no single person can be credited with inventing the compact disk. But if anyone was the driving force behind its development, it is clearly Joop P. Sinjou, technical manager of Laservision Philips International in Eindhoven, the Netherlands.

The compact disk developed under Sinjou's direction contains some 60 minutes of digitized audio programs in the form of microscopically small pits on one side of a 12-cm disk. Its associated optical playback system was only one facet of Sinjou's job. "I like working with people, too," says the 50-year-old Philips manager. "It's a proclivity that came in handy when I had to pull together the various in-house technologies that went into the creation of the compact-disk system during the second half of the 1970s."

Several factors converged in the design and production of the system, notably the firm's know-how in glass technology for record mastering, its savvy in studio techniques, and its expertise in making very large-scale integrated circuits for performing the hundreds of thousands of switching operations that take place every second in the compact-disk player. Philips also called on its experience in solid-state lasers and optoelectronics for signal pick-up, and in telecommunications, on which the disk's pulse-modulation encoding system is based.

Another challenging, and in the end perhaps the most satisfying, role that Sinjou played was getting the compact-disk system standardized. "We made every effort to repeat the success of the compact tape cassette that we pioneered," he explains. A prerequisite for such success was a world standard for the disk so it can be played back with any compact-disk system on the market. "Without a standard, we would have had the same situation that exists in the video recorder market," Sinjou declares.

With this in mind, consultations with another major audio equipment manufacturer, Sony Corp., of Tokyo, resulted in an agreement in 1979, with Sinjou as a key negotiator. Philips included the Sony-proposed modulation and error-correction schemes in its system. A year later—with the added benefit of a powerful Far Eastern partner—the company submitted its compact-disk format to Japan's Digital Audio Disc committee for consideration as a world standard. The committee recommended it as such to audio producers around the world.

A significant point was reached in early 1981 when Matsushita Electric Industrial Co., in Osaka, until then a heavy promoter of the capacitive pick-up audio high-density system, announced that it would adopt the Philips concept. The prime factors that tipped the scales in favor of the Dutch scheme, Sinjou recalls, were its high sound quality, absence of wear from the contactless pick-up device, fast access to any part of the program and, above all, the compactness of both the disk and the player.

Sinjou, who joined Philips in 1952 and studied mechanical engineering at the Technical University of Eindhoven while working at the company, now explores the potential of laser video disks for industrial markets. But he still keeps an eye on activities in the audio compact-disk field.

One ongoing development in that area is the subcode disk, which, beyond reproducing sound, can display the lyrics of a song (or other information) on a TV screen. Another potential new product is a disk for archival purposes—one that stores more than 600 megabytes of information on its 12-cm surface.

For his work on compact-disk systems, Sinjou received numerous prizes from professional groups in Germany, France, Japan, Belgium, and the U.S. One of the most noteworthy was from the National Academy for Recording Arts and Sciences.

–J.G.

---

analog converter. A difficulty associated with this scheme, however, is that the amount of information that must be digitized from even a simple musical composition would overwhelm the disks' capacity.

To overcome the problem, Compusonics Inc., Boston, is developing a data-compression scheme that uses four Texas Instruments Inc. MS320 parallel processors to remove the pauses from a musical piece so that only the tones are recorded. Compression algorithms resident in the processors reinstate the pauses as the music is played back. A 5:1 data-reduction ratio is expected to permit the recording of 12 minutes of music on a 15-megabyte floppy disk.

Melodian Inc., New York, is also working to develop digital music recordings on floppy disks. Should the idea prove successful, it would lower production costs for the disks (versus the relatively high costs for recording onto laser disks) and create an additional product that owners of personal computers would presumably find hard to resist.

–David M. Weber

My hero. Heath/Zenith's Hero Jr. home robot is typical of the state of personal robots. It can entertain, do simple tasks, and act as an unarmed security guard, but more practical uses and the inclusion of artificial intelligence are still a long way off.

use from an arm, a robot requires an extremely expensive navigation system," a Heath spokesman says. The lack of an arm vitiates Hero Jr.'s anthropomorphic qualities as well as its usefulness as a servant that can fetch and carry objects. But the advantage is that a homeowner need not fear the device will accidentally run amok and cause damage while he's asleep or otherwise not looking after the robot.

The most practical use for Hero Jr., according to Heath, is as an (unarmed) security guard. The robot can be programmed to patrol the house along a given pathway while outfitted with a standard ultrasonic motion detector (and an optional infrared detector), and shout a prerecorded challenge to an intruder. The intruder would then have to respond with the correct password. If he or she could not, Hero Jr. could call the police over a wireless interface to a standard telephone, while at the same time shrieking out an alarm. In the past, some demonstration models of home robots have included a tear-gas canister that is activated at the robot's discretion, but these were discontinued because even one false alarm could cause extensive damage to the house.

Tomy Inc., of Japan, has introduced a smaller, less expensive robot for the home that does have arms, although they are not powerful arms. Called Omnibot, the robot can be programmed by the user to pick up a small object and bring it back, but only if the object is in a precisely defined location at the end of a precisely defined path. In most homes, especially those with children, nothing is ever put back exactly where it belongs, and in such an environment, Omnibot would remain a toy. Tomy seems to know this and is advertising it in that spirit—as a high-end toy.

Prospects for 1990

Industry experts agree that the capabilities of today's personal robots are severely limited by the machines' inability to recognize objects. In a typical household, the number and variety of objects can be enormous, and the computational power required to handle the corresponding pattern-recognition algorithms becomes quickly unmanageable.

But by 1990, some analysts predict, the requisite artificial-intelligence systems will have been developed and robots will be able to steer their way around the home using visual cues, as humans do. Similarly, they will be able to accept programs for recognizing objects that they can then manipulate—for instance, fetching a bottle of beer, opening it, and pouring it into a glass.

The AI capability, according to the more optimistic analysts of the robotics market, can be taken care of with a 32-bit microprocessor using 8 megabytes of random-access memory and 20 megabytes of program and pattern-recognition storage. What the optimists don't explain is how the integrated AI systems software is to be written or what it should say. Indeed, if the experience that industrial robotics companies have had thus far with AI is a reliable indicator, profound difficulties await those trying to develop AI for the consumer market a few years from now.

AI is not just an engineering problem that can be solved according to a timetable. It is also a conceptual issue, requiring a breakthrough in thinking. Industry has still not been able to come up with truly flexible pattern-recognition software for machine vision systems costing hundreds of thousands of dollars. It would be surprising if home robot manufacturers could do it for a consumer product anytime soon. **–D.M.W.**

last July—only six months after abruptly resigning from Commodore, the firm he founded and brought to its current position of prominence. Despite some skepticism about whether Tramiel can duplicate his Commodore success, he has promised a revamped, lower-cost version of the $170 Atari 800XL as well as an internally designed 16-bit system for introduction at the Winter Consumer Electronics Show in January.

Japanese caution

U.S. consumers may also get a look next year at the first low-priced computers from Japan based on the 8-bit MSX operating system created by Microsoft Corp., Bellevue, Wash. Supported initially by 14 Japanese manufacturers, MSX systems failed to make their appearance at the Summer Consumer Electronics Show in Chicago last June, as many had expected. Instead, manufacturers such as Sony, Hitachi, Matsushita, and Mitsubishi have so far been content to stay away from the competitive hotbed in the U.S., citing severe competition and an insufficient number of software houses that support MSX among their reasons for holding back. Most MSX hardware producers plan to export systems to Europe beginning this year. But many observers believe that if MSX systems aren't brought to the U.S. soon, they may entirely miss the market window for the low-end 8-bit systems.

In the Japanese market, Sony cites MSX production rates of 13,000 units per month. The firm expects that figure to rise to 20,000 by year-end, with exports to the UK set to begin this month.

Most MSX systems are priced at around $225 and come with either 32-K bytes or the 64-K bytes of user memory required for MSX-DOS, the disk operating system version. But Casio Computer Inc., Tokyo, is taking a new tack this fall with an MSX system that features only 8-K of user memory. Priced at $121, the machine will be promoted primarily as a low-end game-playing system, but it can be expanded to up to 64-K of user capacity. Casio plans to start selling the unit in Japan in October and expects to produce 20,000 of them per month.

While Japanese manufacturers may or may not tackle the U.S. home-computer market next year, one U.S. maker setting its sights on the business is Coleco Inc., whose Adam system is again on retailers' shelves offering built-in word processing, a bundled printer, and substantial game-playing capability. The Stamford, Conn., manufacturer appears to have overcome last year's production problems and is predicting brisk sales this Christmas. Though the Adam system, priced at around $700, lacks a large software base, strong sales during the holiday buying season could attract more third-party software publishers to Adam. –W.R.I.

AUTOMOTIVE

Sensors update vehicle's condition in real time; prototype cars feature electronic navigation equipment

The drive to include more electronic features in the automobile will continue in 1985. AM stereo radios, cellular telephones, and electronic instrumentation panels employing either vacuum-fluorescent or liquid-crystal displays are slated to show up increasingly as standard and optional features in 1985 cars, particularly at the high end.

The Big Three auto makers in the U.S. are experimenting with advanced instrumentation, control, and information systems that feature multifunctional touch-sensitive cathode-ray-tube screens. In Detroit, both Ford Motor Co. and General Motors Corp.'s Buick Motor Division are planning to build prototype cars equipped with CRTs as well as other special features this year for tests under actual driving conditions. If all goes smoothly, CRTs along with other advanced systems could start showing up in limited production models next spring and as soon

Digital driver. Late-model cars have advanced electronics for informing a driver of the vehicle's condition. The Ford Motor Co. Comtech prototype places many interior functions at the driver's fingertips, both in the steering pod and in a touch-sensitive cathode-ray tube.

cluster, GM officials say. The 1985 Corvette will continue that tradition, featuring redesigned graphics in a standard LCD display that provides information on 16 functions. These include both analog and digital speedometer and tachometer readings as well as a range of digital readouts on functions ranging from miles per gallon to more traditional information such as oil pressure and coolant temperature.

Heavenly direction. Drivers may soon be able to plot their exact position with the aid of satellites. Chrysler Corp. has developed an experimental Laser Atlas and Satellite system that uses a 9-in. color TV screen mounted on the vehicle's console area. Chrysler is offering an electronic compass and a 12-function navigator as options on some of its 1985 model production cars.

The Corvette system uses temperature sensors with associated circuitry to slow down the updating sequence from display drivers whenever temperatures drop below 10°F; this avoids garbled digital readouts that could occur from slow LCD response when the car is started in cold weather, GM says. A similar scheme will be used in the LCD instrumentation that GM will be offering as an option on the 1985 Pontiac Firebird.

Other 1985 GM cars—including the Pontiac Grand Am, the Camaro Berlinetta, and the Chevrolet Cavalier—will feature vacuum-fluorescent display clusters as options. A vacuum-fluorescent display package will be standard on the Buick Somerset Regal. Its features include an expandable graphic fuel-gauge display so that a touch of a button converts the display from a full-tank to quarter-tank reading, enabling a more precise indication of how much fuel is left in the tank.

Ford will make its first use of LCDs in its fall 1985 production cars in the form of optional display clusters for its Thunderbird and Mercury Cougar, and on the Aerostar Minivan next spring. To overcome potential visibility problems, these clusters rely on a series of light pipes with high-intensity halogen bulbs as well as polarized filters that direct light through the back of the display. The clusters have three separate modules—one for speedometer and odometer, another to provide trip computer functions, and a third composed of three colors that combines a graphic tachometer readout with digital fuel-quantity display and analog bar graphs for fuel, engine temperature, oil pressure, and voltage.

At Chrysler Corp., instrumentation engineers are sticking with vacuum-fluorescent technology for 1985, although the No. 3 U.S. automaker expects to use LCDs in future model years. Vacuum-fluorescent displays will be a new option in 1985 on the Chrysler LeBaron while being continued on the Laser, the New Yorker, and the Dodge Daytona. From the standpoint of functionality, 1985 Chrysler cars will feature an electronic compass on the New Yorker and a 12-function navigator that provides a variety of trip computer-like functions in the LeBaron Lancer.

Vacuum-fluorescent displays are also included in all Chrysler electronically tuned radios, including the top-of-the-line Ultimate Sound AM/FM stereo with cassette system being introduced for 1985 vehicles. The new system features 36 W of power, a five-band graphic equalizer, six speakers with a joystick speaker control and soft-touch buttons. Also included is a built-in digital clock that doubles as a frequency display when the driver touches the center of the on-off control. Like GM and Ford, Chrysler is relying on the Motorola Inc.-backed system for its AM stereo receivers. The Ultimate Sound radio was designed cooperatively with Mitsubishi Electric Co., Tokyo, which is producing it.

Chrysler will continue in 1985 to offer its voice-alert system that uses speech-synthesis chips from Texas Instruments Inc., Dallas, to provide verbal diagnostic or safety messages to car drivers and occupants. But the firm will also provide a way for car owners to disconnect the voice system, due to complaints received by customers who were annoyed by the 11-message system following its introduction in model year 1983. GM has yet to incorporate speech-synthesis systems in its cars, and Ford last year discontinued its voice system, introduced in 1983, after customers complained. **–W.R.I.** ☐

Charles L. Cohen and Michael Berger in Tokyo contributed reporting to this consumer technology update.

USING PERSONAL COMPUTERS AS SPECTRUM ANALYZERS

With newly available hardware and software, personal computers become a low-cost way to perform real-time spectral analysis in engineering applications ☐ *by Mark S. Darlow*

Real-time spectral analysis is migrating to the realm of personal computers. The necessary hardware is already available, together with some of the software. Additional software is under development and is contributing to the growing use of personal computers in engineering applications.

A prospective user of such a system, however, needs to know the capabilities and limitations of personal computers for spectral analysis. Of particular help is a detailed look at a combination of hardware and software in current use and an examination of some typical applications in this area.

Instrumentation, particularly for spectral analysis, has evolved tremendously during the past 20 years. From simple, manually swept analog filters, it has developed into sophisticated microprocessor-based, multiple-channel, fast-Fourier-transform analyzers and modal analysis systems. Though the capabilities of these instruments far surpass anything imagined two decades ago, so do their prices. Thus while it is easy for the engineer who must use such equipment regularly to justify the expense, the occasional user often cannot.

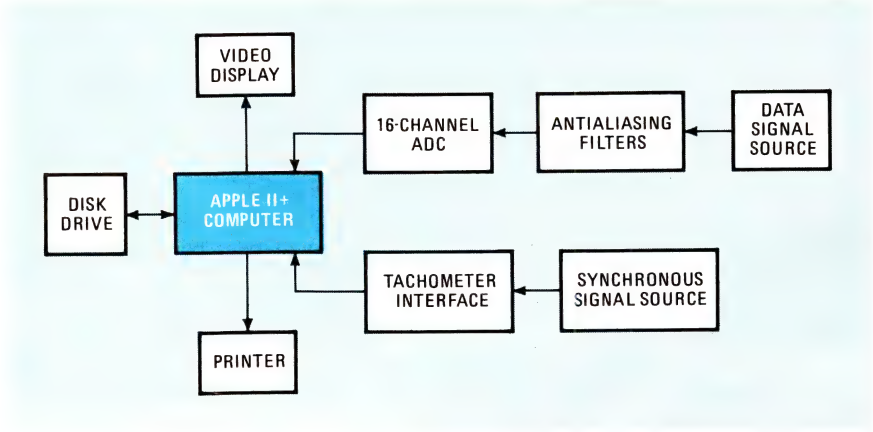
In addition, during the past several years the desktop computer has developed into a machine that can be used for engineering applications. A substantial amount of software has become available for such applications, which replaces those running on mainframes. There is, however, considerably less software available for real-time applications of personal computers—that is, for those applications involving acquisition and analysis of transducer data—although progress is being made in this area.

Spectral analysis is a particular area of real-time applications for which the capabilities of personal computers are well suited, and some software has been developed for interfacing personal computers to standalone instruments, such as spectrum analyzers, for performing programmable analysis of the instrument-generated data. But very little software is currently available to enable a personal computer to be used as a replacement for such spectral-analysis instruments.

The good and the bad

Using the appropriate hardware interfaces (Fig. 1) and software (in assembly language, for speed), many personal computers can acquire data and perform a variety of spectral analyses, including single- or multiple-frequency discrete Fourier transforms (DFTs), FFTs, inverse Fourier transforms (IFTs), correlation functions, and other analyses. Such a machine can perform an FFT calculation considerably faster than it can an equivalent DFT calculation. All frequency components are calculated simultaneously with an FFT, however, while individual frequency components may be separately calculated with a DFT. Thus if only a small number of frequency components are of interest, it may be faster to calculate a partial DFT than a complete FFT. An example of this, a digital tracking filter, is discussed below.

These analyses can be used to emulate existing instrumentation, such as spectrum analyzers. They can also be



1. Analysis system. Linking a personal computer, hardware, and signal source is one way to configure a spectral-analysis system.

would be expected, 12-bit converters are generally more expensive than 8-bit units.

Some converter interfaces provide built-in amplification or attenuation circuits, or both. These features are particularly useful when dealing with low-level data signals or with data signals which have a broad range of voltage levels. Most interfaces have analog multiplexers that can select data from any of a number of channels (usually at least eight). If the system is to provide spectral information for more than one channel of data, including relative phase information (for example, dual-channel FFT), it may be necessary to use two or more converters that are sampled simultaneously—although this can, with some difficulty, be handled in the software.

One other important factor to consider when selecting an ADC is the level of difficulty inherent in writing software to use it and the software support, if any, provided by the manufacturer. The operation and use of the various converters available for any of the personal computers are sufficiently different to preclude the development of standardized software. Consequently, any commercial software that requires the use of an ADC is generally limited to a single model, although several versions of the software may be designed for use with different converters.

Most of the currently available commercial real-time software is supplied by the interface manufacturers and is generic in nature (that is, utility software not designed for a specific application). There does not appear to be much commercial software that is designed for spectral analysis.

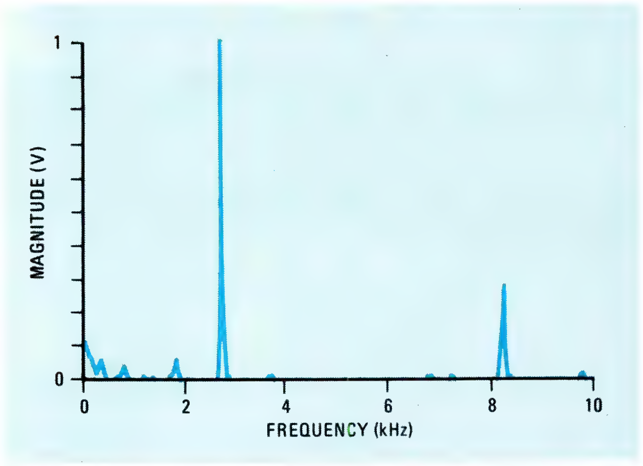
Though there is no point in buying an ADC that is unnecessarily expensive, it is advisable to consider the most stringent requirements of the application before selecting one. Availability of appropriate software is also very important, and the cost of software development should not be underestimated. In many cases, the availability of specific software for an application may dictate the choice of converter.

Special interfaces

For many real-time applications, other types of special interfaces are also required. Some of these interfaces are commercially available, while others may have to be custom made. The Apple is particularly well suited for use with home-brew interfaces. Some of these special interfaces are ADCs with special functions (hardware timing and data buffering, for example), peak detectors, digital inputs and outputs, digital-to-analog converters, tachometers, frequency counters, analog filters (for antialiasing), motor controllers, and robot controllers.

Figure 1 shows a good example of a spectral-analysis system based on a personal computer; it uses an Apple II+ and a commercially available 12-bit ADC. There are many alternative ways to design such a system, and this one should be viewed as only one of many possible approaches.

When assembling a spectral-analysis system based on a personal computer, it is always preferable to use as much in the way of commercial components as possible, particularly interfacing hardware. In this regard, low- to moderate-speed (up to 20 kHz) ADC interfaces for personal computers are readily available in 8- and 12-bit resolutions. Faster or higher-resolution converter interfaces are considerably more difficult to find. Spectral-analysis software for personal computers is also difficult to find, though some is available.



3. With antialiasing filter. When the antialiasing filter is used, the alias-frequency components of the frequency spectrum of a 2,700-Hz square wave are not present.

The 12-bit interface in the system described here has 16 input channels and programmable gains and theoretically can sample at 50 kHz. It has no on-board clock or data buffer, however, and the consequential software overhead reduces the actual maximum sampling rate to slightly over 30 kHz. Still, this is adequate for most applications.

The particular spectral-analysis functions and applications that have been implemented are an emulation of a frequency spectrum analyzer, an emulation of a digital tracking filter, a digital tracking filter with plotting capability, and rotor balancing. In addition to the computer and converter interface, some of these functions use an additional interface, which was designed in-house. This interface has three roles: it acts as an antialiasing (low-pass) analog filter with a software-selectable cutoff frequency, a hardware multiplier, and a frequency counter and tachometer.

Analysis software

A software package has been developed that, together with the hardware described above, emulates a frequency spectrum analyzer. The primary concern in the development of this software was execution speed. Initially, all calculations were done in software, and a reasonable execution time of 1.5 seconds per spectrum update was achieved. The use of a hardware multiplier has subsequently cut this time in half.

To achieve this speed, it was necessary to make certain compromises. The 12-bit input data is scaled to the most significant 8 bits and the FFT calculations are done in 8-bit arithmetic. The number of spectral lines generated is limited to 128 (using 256 data points). Spectral magnitude is retained; phase information is discarded. Only linear plotting is provided, since with 8-bit calculations there is not sufficient resolution for reasonable logarithmic plotting.

Despite these limitations, the resulting software package provides a very impressive, and useful, function. This

SMALL HYBRID HOLDS 16-BIT CONVERTER

Digital-to-resolver converter with 1 arc-minute accuracy rating is compatible with both 8- and 16-bit microprocessors

☐ *by Steve Zollo*

Contained in a 1-in.^{2} hybrid package, a 16-bit digital-to-resolver converter offers up to 1 arc-min accuracy and is compatible with both 8-bit and 16-bit microprocessors. The 28-pin HDR2406 has a radius accuracy to within 0.03%.

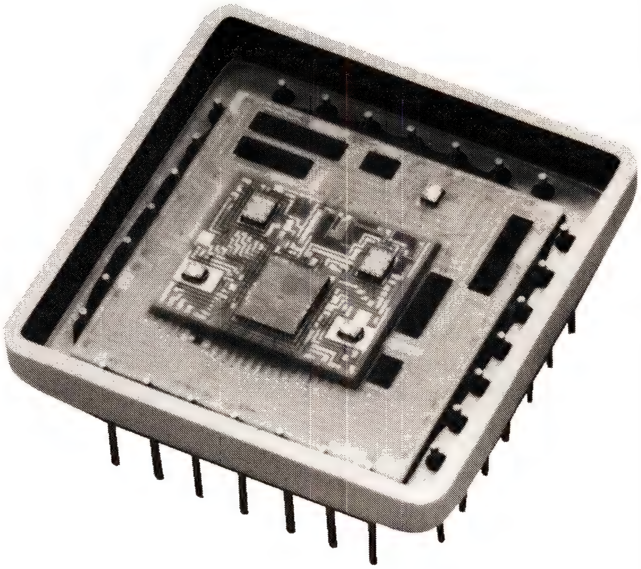
The company attributes the converter's accuracy to a design that uses buffer amplifier circuits—instead of special compensation circuits—to eliminate the effects of analog switch resistance. Designed primarily for use with a resolver of size 15 or larger, the 2406 allows designers to create a fully digital resolver in the space that was previously occupied by the resolver alone, the manufacturer says.

Matched thin-film resistors are used to generate the sine and cosine outputs to assure excellent angular performance over the entire operating temperature range—either 0° to +70°C, –25° to +85°C, or –55° to +125°C. All gain resistors are actively laser trimmed to achieve precise performance.

The 2406 has a pin-programmable reference input and requires a ±15-V power supply. In addition, the 2406 offers double-buffered inputs, dc-coupled reference and outputs, and CMOS and TTL compatibility.

Although designed to interface with most popular microprocessors, the 2406 may be used in conventional applications without any external components or additional connections. For applications not involving a microprocessor, independently controlled 8-bit latching registers give the user the flexibility of designing his own interface system. The manufacturer has provided for asynchronous data inputs through the use of the load converter control function. Asynchronous data inputs up to 16 bits can be accommodated.

All of the converter's data bits are actively pulled down to ground. If the converter requires less than 16-bit resolution, the unused data bit pins may be left unconnected. The high byte enable, low byte enable, and load converter control signals are actively pulled up to a logical high state. When not required by a particular application, these pins may also be left open.



In addition to the model with 1 arc-min accuracy rating, parts are available with accuracies of 2, 4, and 8 arc-min. These accuracies are also guaranteed over the three available operating temperature ranges.

The short-circuit-protected converter has an output settling time of 50 μs at a maximum, an output current of 2 mA root mean square, and a dc zero offset of ±10 mV (±25 mV at a maximum).

Available six weeks after ordering, the 2406 sells for $230 each.

Natel Engineering Co., 4550 Runway St., Simi Valley, Calif. 93063.
Phone (805) 581-3950 [Circle reader service number 338]

Versatile multitasking station offers board options

The system board of the Professional 380 work station has expansion capability and additional option slots that will allow the original-equipment manufacturer to satisfy customer needs in many areas, including engineering, scientific, industrial, and office applications, the manufacturer says. The Professional 380 work station includes a system unit, monochrome monitor, keyboard, and 10-

Four-pen plotter moves at 10 in./s

A multipen, grit-roller plotter automatically selects pens from a self-capping four-pen magazine, plots at nearly 10 in./s axially, and can be adjusted to handle cut-sheet paper or mylar from sizes A through D. The grit-wheel transport system is said to produce a smooth, accurate controlled plot, and a synchro-belt drive is used for quiet, accurate pen control.

Plotter-command-selection functions include vectors of all types, varying line types, circles, curves and curve fittings, a full set of ASCII characters, symbols, foreign characters, axis, hatching, coordinates, status, and alpha control. It links with equipment over RS-232-C or IEEE-488 interfaces.

Plotting at speeds up to 9.8 in./s, it uses ball-point ink (Rotring) or ceramic pens with oil or water base. Pricing and delivery information were unavailable at press time.

Numonics Corp., 418 Pierce St., Lansdale, Pa. 19446.
Phone (215) 362-2766 [Circle 370]

Half-height Winchester stores 26 megabytes

A half-height 5¼-in. Winchester disk drive, the 26-megabyte Shugart 724 offers such data protection features as high-damping four-point shock mounts, a dynamic spindle brake, and an actuator that automatically retracts the read/write heads to a dedicated head landing zone when the drive is powered down. Offering 20 megabytes formatted, the 724 is designed for desktop computers.

The two-platter 724 has a track density of 720 tracks/in., thanks to a closed-loop servo positioning system. Servo data embedded in each recording track provides feedback information to the head and results in more accurate positioning than with open-loop systems.

The 724's printed circuit board includes four custom large-scale integrated circuits to handle the drive's read/write, input/output, and servo functions, and two 8-bit microprocessors to control the spindle and step-

Making wire products? Make them in Macon. Where labor, location and transportation have industry wired to succeed.

Macon

THE NEW CENTER OF THE SOUTH.

For a free audio cassette plus the results of a study on Macon and your industry, call
1-800-MACON-GA.

Circle 67 on reader service card

BARBADOS AND INTERNATIONAL BUSINESS SERVICES.
OUR TAX ADVANTAGES AREN'T OUR ONLY ADVANTAGES.

Barbados is the perfect location for international business and financial services, captive insurance, ship registration and off-shore banking.

Barbados, first of all, is an old established, politically stable country—with an equally stable economy.

We're the financial and insurance hub of the Eastern Caribbean.

We have excellent telephone / facsimile / satellite communications systems.

And highly skilled workers.

We're the center of a web of international air services.

We do offer those quite pleasant tax advantages and, even more importantly, getting money out of Barbados is uncomplicated.

And visiting Barbados (as well as working there) is a lot of fun.

Write us or give us a call for our informative brochure 'Off shore Business in Barbados.'

BARBADOS INDUSTRIAL DEVELOPMENT CORPORATION
800 Second Avenue
New York, NY 10017
(212) 867-6420

"This material is prepared by Van Brunt & Company, Advertising-Marketing, Inc., 300 East 42nd St., New York, New York, registered with the Department of Justice, Washington, D.C. under the Foreign Agents Registration act as an agent of Barbados Industrial Development Corporation, 800 Second Avenue, New York, New York. This material is filed with the Dept. of Justice where the required registration is available for public inspection. Registration does not indicate approval of the contents of this material by the United States Government." U.S. / Foreign Agents Registration No. 1704.

Circle 93 on reader service card

Gould . . . Innovation and Quality in European Electronics
"We need a European materials and components supplier with a range of products as advanced as our own systems and equipment."
"You need Gould"

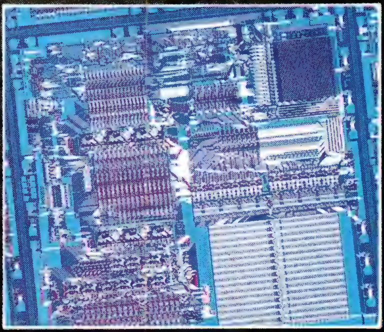
Today's electronic systems and equipment demand advanced components and materials – and no-one is better placed to provide them than Gould.

Gould is one of the world's foremost electronics companies – the largest supplier of ultra-fine copper foil for printed circuits and the world's biggest commercial producer of custom semiconductors, like the integrated circuit pictured right.

In Europe, as in the rest of the world.

Gould is concentrating its inter-related technologies in six rapidly expanding markets: computers, factory automation, test and measurement, medical electronics, defence electronics, electronic components and materials including semiconductors – if it's important to Europe then it's crucial to Gould.

Interested enough to find out more?
Write to Gould, Department P2,
Raynham Road, Bishop's Stortford,
Hertfordshire CM23 5PF, England.



GOULD
Electronics

Circle 94 on reader service card

...the growth factors

You know the companies in he power business that appear o be going downhill, and others hat cannot compete worldwide. ome seem to lack corporate olicy. Others have a poor roduct range or are weak in najor applications.

But constant and aggressive rowth is the description that best its SGS. Our technology is second o none; our increasing number f plants are the most modern, nd our product range is growing ast – fastest in the industry.

1 Over 1000 standard types, covering lmost every application, and growing by ot less than 1 new type every day.

2 Many innovative products including ligh Voltage up to 1500V, Power MOS types nd high power modules up to 35kVA.

3 Seven volume packages – TO-126, OT-82, TO-220, SOT-93, TO-39, TO-3 and O-240.

4 5″ wafer capability, ion implantation nd other state-of-the-art technologies.

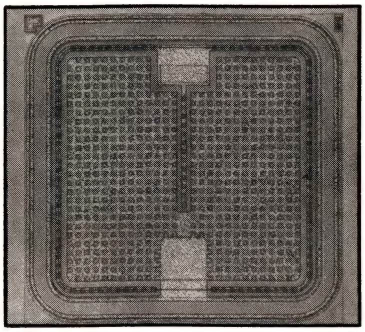
5 Three manufacturing locations in urope and two in Asia.

6 Availability and service from Sales ffices and Distributors worldwide.

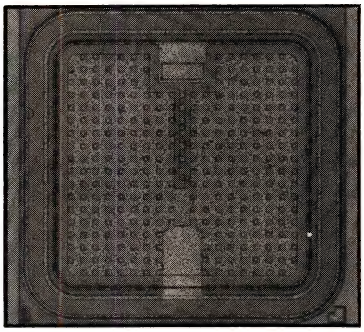
NTERNATIONAL HEADQUARTERS
GS-ATES Componenti Elettronici SpA. Via C. Olivetti, 2.
0041 Agrate Brianza. Tel: 039-65551 Tlx: 330131-330141
enelux B-1180 Bruxelles. Winston Churchill Avenue, 122
el: 02-3432439 Tlx: 24149B · **Brazil** 05413 Sao Paulo. Avenue
lenrique Schaumann 286-CJ33 Tel: 11-853 5062 Tlx: 37988 UMBR BR ·
enmark 2730 Herlev. Herlev Torv, 4 Tel: 02-948533 Tlx: 35411 ·
astern Europe Export Sales Office 20090 Assago (MI).
le Milanofiori, Strada 4, Palazzo A/4/A Tel: 2-8244131 Telex: 330131
GSAGR · **France** 92120 Montrouge. 21-23 rue de la Vanne
el: 1-6571133 Tlx: 250938 F · **West Germany** 8018 Grafing bei
lünchen. Haidling 17 Tel: 08092-690 Tlx: 05-27378 · **Hong Kong**
th Floor, Block N, Kaiser Estate, Phase III. 11, Hok Yuen St. Hung Hom,
owloon Tel: 3-644251/5 Tlx: 33906 ESGIES HX Tel: 0024-10932
taly 20090 Assago (MI). V. le Milanofiori, Strada 4, Palazzo A/4/A
el: 2-8244131 Tlx: 330131 SGSAGR · **Singapore** Singapore 1231.
orong, 4 & 6, Toa Payoh Tel: 2531411 Tlx: ESGIES RS 21412 · **Sweden**
9500 Märsta. Bristagatan 16 Tel: 0760-40120 Tlx: 0024-10932
witzerland 6340 Baar. Oberneuhofstrasse 2 Tel: 042-315955
lx: 864915 · **UK** Planar House, Walton Street, Aylesbury, Bucks.
el: 0296-5977 Tlx: 041-83245 · **USA** Phoenix AZ 85022.
000 East Bell Road Tel: 602 867 6100 Tlx: SGS ATES 249976

Facts about state-of-the-art Power MOS from SGS

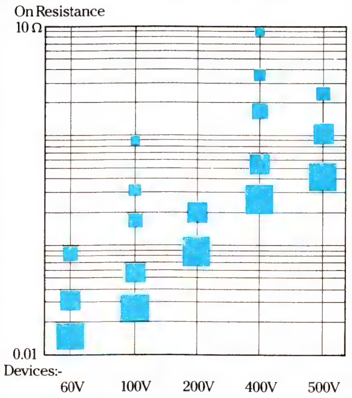
Optimised Power MOS geometries for different voltage ratings combined with proven Power technology make SGS Power MOS transistors the obvious choice to optimise your very high speed switching applications.



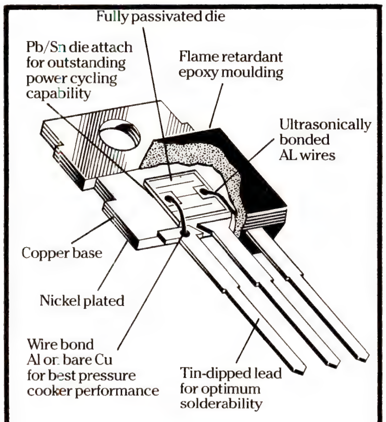
Channel resistance is the limiting factor:
SGS geometry optimised with small cells and minimum spacing.



Drain epitaxial resistance is the limiting factor:
SGS geometry optimised with larger cells and wider spacing.



5 die sizes, 5 voltage ranges and 5 package types give a total product range of over 100 standard devices.


Fully passivated die
Pb/Sn die attach for outstanding power cycling capability
Flame retardant epoxy moulding
Ultrasonically bonded AL wires
Copper base
Nickel plated
Wire bond Al or bare Cu for best pressure cooker performance
Tin-dipped lead for optimum solderability

Power MOS.

Like every SGS Power device, all MOS transistors are available from our worldwide sales organisation. So why not prove these facts for yourself? And gain from our world leadership in power technology.

SGS

Technology and Service

Circle 95 on reader service card

to about 2,000 rules, under OPS83 tens of thousands may be incorporated.

OPS83 runs on the DEC VAX 11/750 and 11/780; versions for other computer systems will be available by the end of 1984.

Available now, OPS83's introductory license fees (effective until January 1985) are $10,000 for the first machine per site and $6,500 for each additional machine; full support for six months is included.

Production Systems Technologies Inc., 642 Gettysburg St., Pittsburgh, Pa. 15206. Phone (412) 362-3117 [Circle 376]

IBM PC package lets users update applications simply

A natural-language application-development environment that lets developers build and update complex interactive applications systems without creating a single line of code can now be accessed from IBM Corp. Personal Computers and compatible systems. Called Appgen, the self-documenting environment was previously available only on supermicrocomputers and minicomputers.

With the package, which uses a menu-driven approach, firms can gather bunches of information from individual computers and have immediate access to a multiuser business environment. Each computer can use its own productivity tools under PC-DOS plus Appgen and Appgen applications under Unix.

Available now, Appgen accounting packages sell for $600 each.

Software Express, 2925 Briarpark Dr., 7th Floor, Houston, Texas 77042. Phone (800) 231-0062 [Circle 377]

Station weeds out bad chips, sends action message

A benchtop unit designed to meet the needs of incoming test, the 2295 Central Station supports the same manufacturer's Scan (Semiconductor Component Analysis Network) software. Scan links the company's 173X series of integrated-circuit test systems to monitor the incoming test process, generate off-line programs, and automatically collect and report on test data.

The 2295 Central Station is based on the Digital Equipment Corp. PDP-11/23 processor. The standard system includes a 65-megabyte Winchester disk and an 8-in. floppy disk, a 160-CPS serial printer, a VT-101 terminal, and cables to connect two component testers. A Scan software license is also included in the price of this system.

Up to three terminals and up to four component testers can be connected to the 2295 station, to simultaneously support Scan data collection and two active users. The 2295 station will be marketed to small to medium-sized incoming-inspection departments as a turnkey solution that will enable them to close the loop with component suppliers, the manufacturer says, at an attractive price.

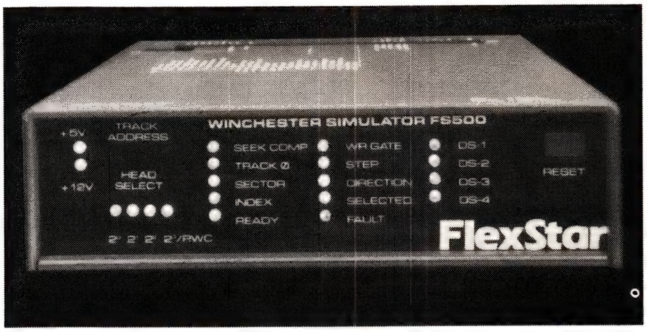
Options offered include additional Scan cables, a stand for the printer and the terminal, and two additional terminals. Optional licenses for Basic and Fortran are available, as well as GRnet, the company's local-area network.

The price of the 2295 Central Station with Scan software is $24,900, and deliveries will begin in November.

GenRad Inc., 300 Baker Ave., Concord, Mass. 01742.
Phone (617) 890-4900 [Circle 343]

Simulators calibrate disk-drive test equipment

Two solid-state products for the disk-drive industry can mimic controller performance and calibrate equipment that correlates disk-drive performance. Called the FS400 Floppy Simulator and the FS500 Winchester Simulator, the two units electrically simulate disk-drive read and write functions as well as common mechanical faults.



The simulators test the full parameters of all 5.25-in. and 3.5-in. floppy and Winchester drives with industry-standard SA400 and ST506 interfaces. Once formatted, sector updates and reads are performed in the same way as with an electromechanical disk drive. A light-emitting-diode display informs the user of problems.

The units act as one-track unformatted disk drives. When formatted with modified frequency-modulated encoding, they allow a range of drive test and data verification, including programmed faults for both the drive and controller.

The units can stand alone or can be controlled by a

Video board and software capture images for IBM PCs

A combination video input-output board, the model DT2803, and Videolab software are compatible with IBM Corp.'s Personal Computer and PC/XT. The package is recommended by the manufacturer for applications in industrial inspection and assembly, as well as in medicine and graphics.

The DT2803 captures a black-and-white image of 256 by 256 by 6 bits, and the red-green-blue output handles 64 colors by 64 intensities and includes cursor control. For applications requiring high-speed calculations, data stored in the frame memory can be passed to the compatible SKY320-PC arithmetic coprocessor, independent of the IBM PC bus.

Videolab, written in C, supports the following frame operations: manipulation, baseline correction, merge, difference, swap, convolution, and histogram. A tutorial, Videotutor, is supplied, and Videosub, a library of subroutines for user-defined applications programs, supports all the functions of the DT2803.

The DT2803 board is single-unit-priced at $1,495. Videolab, including the user manual, is priced at $995. Both products are delivered 10 days after receipt of order.

Data Translation, 100 Locke Dr., Marlboro, Mass. 01752. Phone (617) 481-3700 [Circle 347]

Mouse-based color graphics enhance graphs and charts

PC Paint, a mouse-based color-graphics package for IBM Corp. Personal Computers including the PC AT, can be bundled with the same manufacturer's optical PC mouse to enhance graphics presentations. For painting and drawing, the program features a color bar, line-width box, patterns, shapes, and a repertory of basic drawing tools and tool commands.

PC Paint not only creates pictures; it also enhances graphs and charts created with other applications programs, such as Lotus pie charts, for business and scientific purposes. Font commands set the type font and size of text, and file commands handle entire picture files. Pictures can be printed on either a dot-matrix or a color inkjet printer through the standard screen dump interface.

Picture files are compatible with the Polaroid Palette for color slides or print photography. Designer Pop-up menus, which come with the PC mouse, can be used to run many applications programs. Retail price of PC Paint is $99, while the mouse is sold separately at retail for $195; or the two products are available bundled for $220, a saving of $74. Both are currently available.

Mouse Systems Corp., 2336H Walsh Ave., Santa Clara, Calif. 95051. Phone (408) 988-0211 [Circle 348]

Graphics station converts drawings into CAD files

With productivity gains of up to 10 times over manual computer-aided design input claimed, the 4991S1 graphics input work station automates the conversion of hard-copy drawings into CAD data-base files. The 4991S1 automatically scans and vectorizes documents, converts the vectorized data into high-level graphics primitives (lines, arcs, etc.), and transmits the structured graphics data to host mainframes for storage in the data base.

System components include the 4991 autovectorizer, the M4115B display terminal, the 4957 graphics tablet, graphics structuring software, and host-interfacing software. The autovectorizer accepts drawings submitted on paper, Mylar, or other media in sizes up to 35 by 47 in. (E size).

Setting up requires only identifying the drawing quality, size, input media, and desired output protocol. Adjustments can be made for hard-to-scan documents and media with different contrast ratios, and custom parameters can be stored.

During graphics structuring, the user can select functions that include line straightening and semiautomatic primitives replacement. Smudges or creases on the hard copy can then be eliminated, and specific areas of the drawing can be color-tagged or identified by letter or number.

ere is a symbol for temperature. There is a symbol
its measurement too: AOIP. AOIP thermometers
suitable for all applications.
itration: high fidelity calibration thermometers.
ket thermometers: double resolution thermometers.
el thermometers: thermometers covering a very
le range.
r contactless temperature measurements: a large
ice of optical pyrometers.
r instruments have a worlwide reputation for
uracy, ruggedness and ease of use. And there is no
er on AOIP prices either.
IP Mesures, 8 à 14, rue Charles Fourier, BP 301
24 Paris Cedex 13 - France - Tél. : (1) 588.83.00
ex : 204 771.

AOIP
MESURES
The french precision.

Circle 98 on reader service card

monitoring of four variable resistive inputs and four digital inputs. When combined with the real world interface, the port allows the PC to interface with a number of general-purpose instruments.

The BSR line controller sends ultrasonic signals to a BSR X-10 unit, permitting the control of up to 16 ac devices. Other features that enhance computers are a memory that is expandable from 64-K to 256-K bytes, a clock/calendar, and serial and parallel peripheral ports. Software for configuring the PC's memory into a random-access memory disk and print spooler is included to save processing and printing time.

Selling for $449, the card is available now.

Orange Micro Inc., 1400 N. Lakeview Ave., Anaheim, Calif. 92807.
Phone (714) 779-2772 [Circle 350]

Motherboard accommodates 44-line bus systems

Designed especially for 44-line bus systems, a fully-assembled eight-position motherboard, Model 4616-8, accommodates the company's Americard prototyping circuit boards as well as RCA Corp.'s Cosmac cards. The Americards have 22-pin card-edge connectors on each side spaced 0.156 in. apart.

Using the model 4616-8, designers can assemble analog and digital prototype circuit cards into a system and designate any signals they choose on the bus lines. Alternatively, they may use the RCA bus convention with lines specified for data, address, control, and power.

All bus lines are parallel to the eight connectors on pins A through Z and 1 through 22. Pads are provided for decoupling capacitors between each connector on the +5-V and the auxiliary power lines. The motherboard also has a six-pin quick-disconnect connector for external power with +5-V, ±15-V, spare, ground, and reset lines. Measuring 6.75 long by 4.33 wide by 0.80 in. high including connectors, the board is fabricated of 0.062-in.-thick epoxy-glass material with pads and buses made of ½-oz copper.

Priced at $130.80, the board will be available from stock beginning in December.

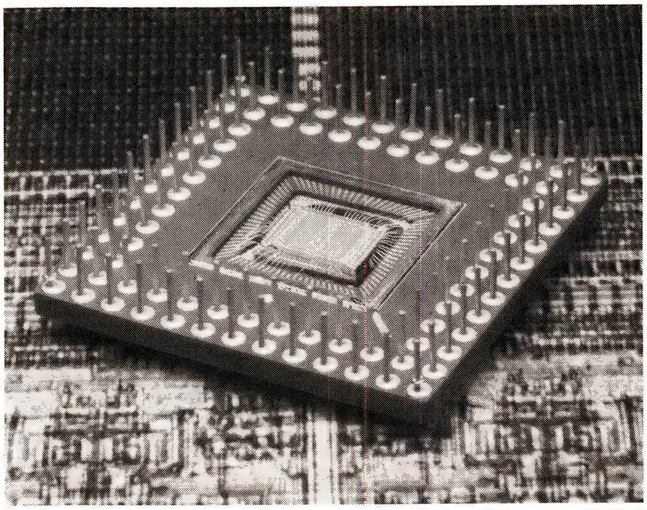
Vector Electronic Co., 12460 Gladstone Ave., P.O. Box 4336,
Sylmar, Calif. 91342. Phone (818) 365-9661 [Circle 353]

5,000-gate PAL works at speeds above 16 MHz

A high-density programmable array logic circuit, the model PAL64R32, is an addition to the company's MegaPAL series. Packed with the equivalent of 5,000 gates, the circuit has 64 device inputs and 32 registered outputs, can operate at speeds above 16 MHz, and features an output drive of 8 mA.

The part is a workable alternative to gate arrays, according to the company, and lets the user bring a high-density product into the marketplace quickly. The circuit incorporates all the features found in its predecessor, the PAL32R16, including Product Time Sharing, a technique that affords designers flexibility in handling large numbers of product terms by allowing 16 of them to be shared between two outputs.

Embedded in the PAL64R32 are four banks of eight bypassable registers, which are capable of performing registered or combinatorial operations on a bank-by-bank basis. One clock input per bank allows asynchronous operation. The company's enhanced Palasm software and a standard programmer work in conjunction with the PAL64R32 to assemble logic equations.



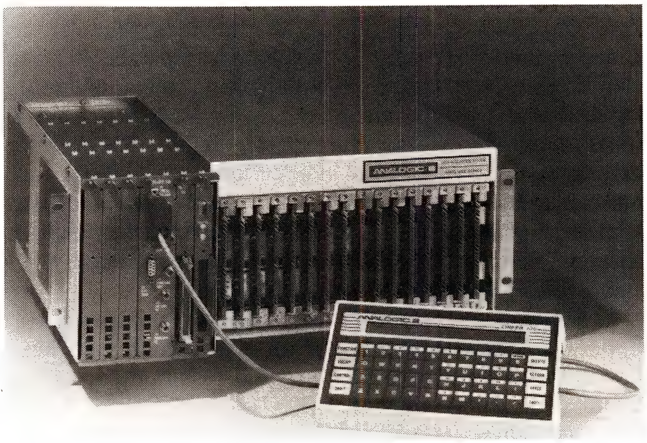
Available in 84-pin leadless chip carrier and 88-pin pin-grid array packages, the parts cost $215.91 and $225.33 each, respectively, in quantities of 100.

Monolithic Memories Inc., 2175 Mission College Blvd., Santa
Clara, Calif. 95050. Phone (408) 970-9700 [Circle 354]

Data-acquisition system offers distribution abilities

A data-acquisition system, the ANDS 5600, features high-speed fiber-optic communications links, extensive distribution capabilities, and local system intelligence. Typical applications include plant monitoring, pipe-vibration analysis, aircraft research, and semiconductor manufacturing.

The ANDS 5600 provides microprocessor control of



nication ports operating at 110 to 19,200 baud. A 110-key keyboard is said to be fully programmable, and the terminals will tilt 12 in. and rotate 360°.

Prices for the XL series start at $1,395, and the terminals will be available in November.

Ann Arbor Terminals Inc., 6175 Jackson Rd., Ann Arbor, Mich. 48103. Phone (313) 663-8000 [Circle 358]

Line of 168 furnaces can heat-treat to 2,380°F

A line of furnaces, the Econo-Heat 2900 series, produces temperatures as high as 2,380°F and includes 168 models ranging in price from $270 to $7,000. The furnaces, used in applications such as ceramic firing, heat treating, and thermal cycling, feature front-access ports, thermocouple ports, and rugged, quick-acting door clamps.

Standard models can by modified to customer specifications with options that include regulated vents to expel volatile fumes, additional lead-in ports, or temperature-control systems.

Aremco Products Inc., P.O. Box 429, Ossining, N.Y. 10562.
Phone (914) 762-0685 [Circle 360]

Deposition system speeds semiconductor metalization

The Mark 50 thin-film deposition system is said to offer improved throughput, payloads for larger wafers, and shorter production cycles in the metalization of semiconductors. Utilizing a Dual-Phase pumping configuration for handling high gas loads, the deposition system offers better process control that makes all aspects of the cycle programmable. Maximum throughput is 300 3-in. or 150 4-in. wafers per hour.

The system is available with single and multiple electron-beam sources. Process parameters may be changed without downtime, and the unit can be equipped with quartz lamps up to 16 kW to produce wafer temperatures over 500° C.

The pump array may be released quickly, and the trap rolls out for maintenance. Four clamps release the chamber for cleaning.

CHA Industries, 365 Haven Ave., Menlo Park, Calif. 94025.
Phone (415) 363-8011 [Circle 359]

Small PBX's features rival those of larger system

A phone system called Alexis interfaces with personal computers and is said to offer features available only on large private branch exchanges. The system currently handles five outside lines and 12 extensions.

A speech synthesizer in the system provides assistance with standard features that include detail recording and remote access to the microcomputer's data base. Data on the disk can be retrieved remotely with a tone-key telephone using the speech synthesizer.

The system connects to the IBM Corp. Personal Computer or compatible units through an RS-232-C interface and does not interfere with normal operation. It uses standard telephone sets.

Packaged in an 18-by-13-by-8-in. wall-mounted cabinet, the Alexis system comes with all tools and connectors needed for installation. The system is available in three different configurations: two lines with five extensions selling for $2,995; four lines with 10 extensions priced at $3,995; and five lines with 12 extensions, which goes for $4,200. It is available now, with software enhancements soon to come.

Adax Inc., 6961 Peachtree Industrial Blvd., Norcross, Ga. 30071. Phone (404) 662-1504 [Circle 363]

COLCOAT 515
STOPS
Electrostatic Damage

Protect delicate LSI and IC chips from electrostatic damage with COLCOAT 515, a unique, alcohol-based liquid. One application of COLCOAT 515 on a chip carrier case prevents electrostatic buildup for more than two years. It dries quickly to form a tough, protective coating.

Japan's leading electronics makers use COLCOAT 515 because of the almost 100% perfect protection it affords. The incidence of rejection due to damage from static electricity is less than one in a million. Specify COLCOAT 515 to ensure the damage-free deliveries your customers want.

COLCOAT CO., LTD.
3-28-1 Omori-nishi, Ota-ku, Tokyo 143, Japan.
Phone: (03) 762-8526. Telex: 0246-7481 COLCOT J

Circle 79 on reader service card

For Space Reservations
Call: Production Dept.
(212) 512-3140

ELECTRONICSWEEK
SPECIAL REPORT
DECEMBER 3

Fifth Generation Computers

- The Japanese Fifth Generation Project
- Other National Projects
- Advanced Computer Architecture
- Artificial Intelligence

Issue Date: December 3, 1984
Closing for Advertising:
November 12, 1984

ElectronicsWeek
The Voice of the Industry,
Heard Every Monday

Meetings

International Automation Systems and Microelectronics Exhibition, Fast-Federazione delle Associazioni Scientifiche e Techniche (Segreteria della Mostra/Exhibition Secretariat: Viale Premuda, 2-20129 Milan, Italy), Milan Fairgrounds, Dec. 3-4.

Semicon/Japan '84, Semiconductor Equipment and Materials Institute (William F. Galarneau, SEMI, 625 Ellis St., Suite 212, Mountain View, Calif. 94303), Tokyo International Trade Center, Tokyo, Dec. 3-5.

Digital Avionics Systems Conference, IEEE (Randal K. Moore, General Dynamics, P.O. Box 748, MZ 2452, Fort Worth, Texas 76101), Baltimore, Md., Dec. 3-6.

Educatec '84, Second Exhibition for Teaching and Training Equipment, Material and Techniques, Edit Expo International (Sylvie Danon, 12 rue Leon-Cogniet, 75017 Paris, France), Porte de Versailles, Paris, Dec. 3-7.

Scan-Tech '84, Automatic Identification Manufacturers Inc. and The Material Handling Institute Inc. (Automatic Identification Manufacturers Inc., 1326 Freeport Rd., Pittsburgh, Pa. 15238), Cincinnati Convention Exposition Center, Cincinnati, Dec. 4-6.

1984 Western Design Engineering Show, American Society of Mechanical Engineers (Show Manager, Western Design Engineering Show, 999 Summer St., Stamford, Conn. 06905), Moscone Center, San Francisco, Dec. 4-6.

Fourth Videodisc, Optical Disk, and CD-ROM Conference, Meckler Communications (520 Riverside Ave., Westport, Conn. 06880) Washington Hilton, Washington, Dec. 5-7.

California Computer Show, Norm DeNardi Enterprises (289 S. San Antonio Rd., Suite 204, Los Altos, Calif. 94022), Hyatt Hotel, Palo Alto, Dec. 6.

1984 IEEE International Electron Devices Meeting, IEEE (Melissa M. Widerkehr, Courtesy Associates, Inc., 655 15th St. N.W., Suite 300, Washington, D.C. 20005), San Francisco Hilton and Towers, San Francisco, Dec. 9-12.

Sixth DEC-Compatible Industry Exposition, Expoconsul International Inc. (55 Princeton-Hightstown Rd., Princeton Junction, N.J. 08550), Disneyland Hotel, Anaheim, Calif., Dec. 11-14.

Computer Networking Symposium, IEEE and National Bureau of Standards (Robert Rosenthal, B226 Technology Building, NBS, Washington, D.C.), Gaithersburg, Md., Dec. 12.

1985

Com-Struct '85, Slater Publications Inc. (Com-Struct '85, 163 Highland Ave., Needham Heights, Mass. 02194), Bayside Exposition Center, Boston, Jan. 8-10.

Seminars

Computer Graphics for Business, Technology Transfer Institute (741 Tenth St., Santa Monica, Calif.), TTI, Santa Monica, Calif., Nov. 26-28.

Practical Statistical Analysis with Reliability Applications, Reliability Analysis Center (RADC/RAC, Griffiss Air Force Base, N.Y. 13441), Sheraton-Twin Towers, Orlando, Fla., Dec. 3-6.

The Engineer as Manager, Pace University (Midtown Center, 535 Fifth Ave., New York, N.Y. 10017), Pace University, New York, Dec. 6-7.

New Public Policies and Medical Technology, Association for the Advancement of Medical Instrumentation (AAMI, 1901 N. Fort Meyer Dr., Suite 602, Arlington, Va. 22209), Hyatt Regency Crystal City, Arlington, Dec. 10-11.

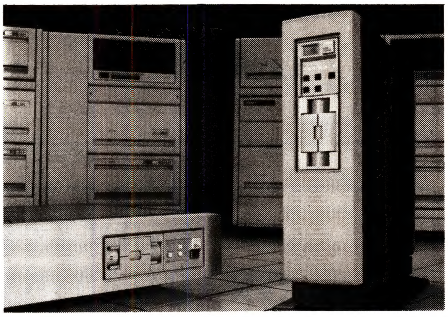
Long-Range Information Systems Planning, American Management Associations (135 W. 50 St., New York, N. Y. 10020), Orlando Hilton Inn, Orlando, Fla., Dec. 10-12.

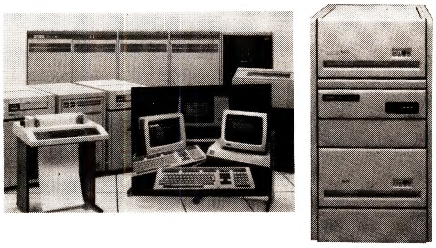
UNITRONIX distributes DIGITAL computers

As a member of Digital Equipment Corporation's network of independent computer distributors, Unitronix can define your needs and help you choose the right Digital computer system for your company. Best of all, Unitronix provides fast delivery of your Digital computer from our multi-million dollar inventory.

Powerful systems using these CPUs . . . tailored to your needs

- Micro 11
- PDP-11/23+
- PDP-11/24
- PDP-11/44
- PDP-11/73
- MICROVAX I
- VAX 11/725
- VAX 11/730
- VAX 11/750
- VAX 11/782





COMPLETE DATA SYSTEMS
with Unitronix-developed standard, customized and custom applications software

CALL TODAY . . .
FOR LATEST PRICING, DELIVERY
. . . AND LEASE OR RENTAL INFO
(201) 231-9400

UNITRONIX CORPORATION
AUTHORIZED digital® COMPUTER DISTRIBUTOR

50 County Line Road
Somerville, NJ 08876
(201) 231-9400 ■ TELEX: 833184

Circle 81 on reader service card

An Alternative for Advertisers to Reach Design Engineers

Editorial:

Military/Space Electronics Design is devoted entirely to international coverage of the military/space segment of the electronics industry. It is produced by a team of experienced technical editors dedicated to providing readers with the most complete and accurate technical information available. A typical issue includes detailed technical articles focusing on significant trends or techniques authored by industry experts, provides in-depth technical articles and introduces new products.

Circulation:

25,000 qualified electronic design engineers specifically responsible for the design and manufacture of military/space electronic equipment and systems, worldwide.

1984 Special Introductory Rates:

Ad size	ElectronicsWeek advertisers	Non ElectronicsWeek advertisers
1 page:	$1,000	$1,500
2/3 page:	750	1,125
1/2 page:	620	930
1/3 page:	400	600
1/4 page:	320	480
1/6 page:	220	330
Cover rates		
4th cover:	2,160	2,635
3rd cover:	1,710	2,260
2nd cover:	1,810	2,410

Color charges:	
Two color, standard:	305
Matched 2nd color:	510
4 color process:	610
4 color process spread:	950

Issue and Closing Dates:

Issue dates	Closing Dates
Premier Issue	
October 15, 1984,	September 15, 1984
December 15, 1984	November 15, 1984

No Waste Circulation:

Military/Space Electronics Design is a targeted and cost-efficient way to get your advertising read by military/space electronic equipment design engineers, worldwide.

For space reservations, call Production Dept., McGraw-Hill Electronics Publications, (212) 512-3140, 1221 Avenue of the Americas, New York, N.Y. 10020.

Advertisers Index

	Advertiser	Page
	A.I.O.P. Mesures	3E
	Barbados Industrial	67
	Bausch & Lomb	45
‡	Carroll Touch	7
	Colcoat CO., LTD.	79
	Digital Equipment Corp.	30-31
	ELXSI	21
	Fag Sa Lausanne	4E
*	Ferranti Electronics	7
■	General Instrument Microelectronics	28-29
■ *	Gould Incorporated	69
	Government of Puerto Rico	38
	Hamilton/Avnet Electronics	4th C
‡	Invest in Britain	71
	Kyowa Elect. Products	4E
‡	Livingston Development	9
	Macon Chamber of Commerce	67
‡	Micro Component Technology	69
■	Murata Manufacturing Company LTD.	2E
	National Semiconductor	2nd C, 1
*	NEC Electronics GMBH	5
	Nicolet Computer Graphics	10
*	Olivetti & CO.	72
‡	Panasonic	5
	Philips T&M	46
	Rohde & Schwarz	1E
*	SGS Ates	70-71
	Telefunken	3
	Televideo Systems	3rd C
	Teradyne Incorporated	22-23, 36-37
	Texas Instruments Inc.	40-44
	Unitronix Corporation	81

Classified and employment advertising

Grumman 60

- ■ For more information of complete product line see advertisement in the latest Electronics Buyers Guide
- * Advertisers in International edition
- ‡ Advertisers in domestic edition

Advertising Sales Staff

Atlanta, Ga. 30319: Don Seay
4170 Ashford-Dunwoody Road N.E.
[404] 252-0626
Boston, Mass. 02116:
Joanna Henderson
575 Boylston St.
[617] 262-1160
Chicago, Ill. 60611
Betsy A. Otto [312] 751-3739
William J. Higgens III [312] 751-3738
645 North Michigan Avenue
Cleveland, Ohio 44113: Joe Milroy
[215] 496-3800
Costa Mesa, Calif. 92626: Debbie Smith
3001 Red Hill Ave. Bldg. #1 Suite 222
[714] 557-6292

Dallas, Texas 75240: Harry B. Doyle, Jr.
5151 Belt Line Road, Suite 907
[214] 458-2400
Englewood, Co. 80112: Harry B. Doyle, Jr.
7400 South Alton Court Suite 111
[303] 740-4633
Houston, Texas 77040: Harry B. Doyle, Jr.
7600 West Tidwell, Suite 500
[713] 462-0757
Los Angeles, Calif. 90010: Chuck Crowe
3333 Wilshire Blvd.
[213] 480-5210
New York, N.Y. 10020
Matthew T. Reseska [212] 512-3617
Albert J. Liedel [212] 512-3616
1221 Avenue of the Americas
Palo Alto, Calif. 94303:
Larry Goldstein, Lauren Scott, Lynne Simonfy
1000 Elwell Court, [415] 968-0280
Philadelphia, Pa. 19102: Joseph Milroy
Three Parkway, [215] 496-3800
Pittsburgh, Pa. 15222: Joseph Milroy
Suite 215, 6 Gateway Center, [215] 496-3800
Southfield, Michigan 48075: Betsy A. Otto
4000 Town Center, Suite 770, Tower 2
[313] 352-9760
San Francisco, Calif. 94111:
Larry Goldstein, Lauren Scott, Lynne Simonfy
425 Battery Street
[415] 362-4600

Brussels: Art Scheffer
23 Chaussee de Wavre
Brussels 1040, Belgium
Tel: 513-73-95
Frankfurt/Main: Fritz Krusebecker, Dieter Rothenbach
19 Liebigstrasse, Germany
Tel: 72-01-81
Milan: Savio Pesavento
1 via Baracchini, Italy
Tel: 86-90-656
Paris: Jean - Christian Acis
17 Rue-Georges Bizet, 75116 Paris, France
Tel: 720-33-42
Scandinavia: Andrew Karnig
Finnbodavagen
S-131 31 Nacka
Sweden
Tel. 46-8-440005
Telex: 17951 AKA S
Tokyo: Akio Saijo
McGraw-Hill Publications Overseas Corporation,
Kasumigaseki Building 2-5, 3-chome,
Kasumigaseki, Chiyoda-Ku, Tokyo, Japan
[581] 9811

United Kingdom: Art Scheffer
34 Dover Street, London W1
Tel: 01-493-1451

Business Department

Frederick J. Kostbar
Business Manager/Controller
[212] 512-2627
Leon Irgang
Circulation Director
[609] 426-5542
Archie Anderson
Director of Marketing Services
[212] 512-6642
Margery D. Sholes
Research Manager
[212] 512-3191
Frances M. Vallone
Reader Service Manager
[212] 512-6058
Thomas M. Egan
Production Director
[212] 512-3140
Carol Gallagher
Production Manager
[212] 512-2045
Betty Preis
Production Manager
[212] 512-2908
Amy M. Ziebarth
Production Assistant
212 512-2843

Classified and Employment Advertising

[212] 512-2556

Never Again Choose Between Price and Quality.

The competition says you must sacrifice one for the other. What they're really saying is they can't give you both. Introducing the TeleVideo® 921. Proof that low price and high quality do go together.

But don't let its low price fool you. The 921 is years ahead with features taken from our most expensive terminals. Like selectable embedded or nonembedded field attributes. 32 nonvolatile function keys. 6 fast edit keys. And something we're famous for: indepth support. Including technical assistance, service training and award winning documentation.

One glance at its nonglare green screen with true tilt and swivel. One pass over its low profile, sculptured keyboard. And you know this terminal is built right. In fact, the 921 is built to the highest quality standards in the industry—our own. We use modular subassemblies. All components are pretested and prestressed. Boards are mounted vertically to run cooler, last longer. There's even room to plug in upgrade options. Like our low cost, Tektronix® compatible graphics board.

The point is this. Don't sacrifice either price or quality. Get both. Get the new TeleVideo 921.

Call toll free, **(800) 538-8725.** In California, call **(408) 745-7760.**

Regional Sales Offices: California/Santa Ana (714) 476-0244, California/Sunnyvale (408) 745-7760, Georgia/Atlanta (404) 447-1231, Illinois/Chicago (312) 397-5400, Massachusetts/Boston (617) 890-3282, New York/New York (516) 496-4777, Texas/Dallas (214) 258-6776

The TeleVideo 921

TeleVideo

Terminals

TeleVideo Systems, Inc.

Tektronix is a registered trademark of Tektronix, Inc.

Circle 901 on reader service card